

(19) World Intellectual Property  
Organization  
International Bureau



(43) International Publication Date  
9 December 2004 (09.12.2004)

PCT

(10) International Publication Number  
**WO 2004/105878 A1**

(51) International Patent Classification<sup>7</sup>: A62B 7/08

(21) International Application Number:  
PCT/US2004/016980

(22) International Filing Date: 28 May 2004 (28.05.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
10/449,918 29 May 2003 (29.05.2003) US  
60/534,329 5 January 2004 (05.01.2004) US

(71) Applicant (for all designated States except US): THE  
HOLMES GROUP, INC. [US/US]; 1 Holmes Way,  
Milford, MA 01757-1516 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): THOMPSON,  
Stanley, O. [US/US]; 92 Town Farm Road, New Boston,

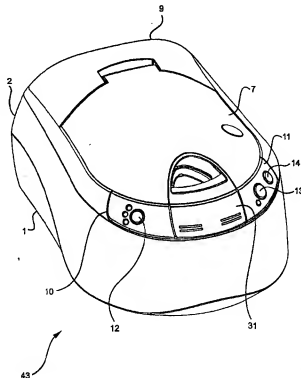
NH 03070 (US). SILVEIRA, Richardo [US/US]; 85  
North Street, Bridgewater, MA 02324 (US). BOSSA,  
David [US/US]; 55 Hazel Street, Uxbridge, MA 01596  
(US). JAYARAM, Jaldeep [US/US]; 62 Silver Hill Road,  
Milford, MA 01757 (US). CHANG, Bruce [CN/US]; N°  
947 Lin Sen Road, 413 Wu-Wong, Tai-Chung, Taiwan  
(TW). WESTRING, Brice, Daniel [US/US]; 5674 Glen  
Oaks Drive, Mason, OH 45040 (US). FANTA, Keith  
[US/US]; 5767 Kempton Court, Liberty Township, OH  
45044 (US). BUSH, Stephan, G. [US/US]; 6426 Cedar  
Hill Drive, Hamilton, OH 45011 (US). TRACY, James,  
J. [US/US]; 864 Oak Hill Avenue, Attleboro, MA 02703  
(US). MAK, Chi Kln John [-ACN]; 9B, Kiu Hong  
Building, 3-5 Tin Lok Lane, Wan Chai, Hong Kong (CN).

(74) Agents: HOFFMANN, Charles, R. et al.; Hoffmann &  
Baron, LLP, 6900 Jericho Turnpike, Syosset, NY 11791  
(US).

(81) Designated States (unless otherwise indicated, for every  
kind of national protection available): AE, AG, AL, AM,

[Continued on next page]

(54) Title: APPARATUS FOR DISPERSING VOLATILE MATERIALS INTO THE ENVIRONMENT



(57) Abstract: The present invention is a device for playing a cartridge (42) for dispersing scented materials into a room. The cartridge (42) generally has a plurality of scent elements supported on a rotatable disk. The device includes a housing (1,2), a blower assembly (70), a platter (19), a motor (35A), first and second sensors (52,53) and a control unit (73). The housing (1,2) has a cavity (47) for receiving the cartridge and is formed with an air intake (50) and an exhaust port (51). The blower assembly (70) is mounted within the housing (1,2) for generating an airflow by drawing air in through the air intake (50) over the cavity (47) to diffuse at least one of the plurality of scent elements out through the exhaust port (51). The platter (19) is configured to engage the rotatable disk and is rotated by the motor (35A). The platter (19), first and second sensors (52,53) and a control unit (73) cooperate to control the rotation of the disk. The device can also include a heating element (45) for activating the scent elements.

WO 2004/105878 A1

**BEST AVAILABLE COPY**



AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) **Designated States** (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI,

FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Published:**

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

**APPARATUS FOR DISPERSING VOLATILE MATERIALS  
INTO THE ENVIRONMENT**

[0001] This application claims priority to United States Patent Application number 10/449,918 filed on May 29, 2003 and United States Provisional Application number 60/534,329 filed on January 5, 2004, which are incorporated herein by reference.

**BACKGROUND OF THE INVENTION**

**Field of the Invention**

[0002] The present invention relates generally to a method and apparatus for dispersing volatile materials into the environment. In particular, the present invention is directed to a device that disperses a plurality of different scents into the air. The present invention is also directed to a device for rotating an object a predetermined range about an axis.

**Brief Description of the Prior Art**

[0003] PCT Publication WO 02/09772 discloses a device for dispensing a plurality of scents into the air. The device 20 employs a replaceable cartridge 22. The cartridge can include a plurality of different scent elements. The cartridge 22 is designed so that all of the scent elements are sealed when the cartridge is removed from the device 20. The plurality of scent elements can be supported on a circular rotatable disk 46 formed with a plurality of pockets 44. The pockets 44 are arranged to have a blank space located between at least two of the pockets 44. The plurality of scent elements are preferably in the form of a gel, but can include: solids, liquids, beads, encapsulates, wicks, carrier materials, and combinations

thereof. The plurality of scent elements can be related to an overall "theme" or "physiological effect." For example, the plurality of scent elements can all be fruit scents.

[0004] The device 20 disclosed in PCT Publication WO 02/09772 generally includes a component for activating the scent elements and a component for diffusing the aromatic materials. The component for activating the scent elements can be one or more heating elements 132. The component for diffusing the aromatic materials can be a fan 134. The device can include a mechanism for aligning the heater 132 with one or more scent elements, or the device can be configured to include a heating element located under each pocket 44. The device 20 includes a motor 142 and a pair of gears 144, 146 for rotating the disk 46 within the cartridge 22. The gears include a worm gear 146 and a plate gear 144 that are configured to rotate a shaft 138 that engages the disk 46. The device 20 includes electronic controls which can be configured to allow the user to: start and stop the device; control the volume and intensity of the scent; and control the selection of the scent including skipping a scent that is included in the cartridge 22.

[0005] PCT Publication No. WO 00/12143 discloses an odor dispensing device and cartridge. The device includes a housing and a disc shaped cartridge. The cartridge is adapted to move around its rotation axis and includes a plurality of radially arranged compartments which contain an odorant carrier. The device includes a fan 21 for producing an airstream which is directed to a selected compartment. The cartridge is rotated by a drive belt 38 and can include a number of scents. The device is configured to position the cartridge and produce an airstream to the selected compartment in response to a signal from: a computer control module; a microprocessor; an optical system; or a timing mechanism.

[0006] United States Patent 5,805,768 to Schwartz, et al. discloses an apparatus for diffusing aroma therapy oils which allow the user to pre-select a variety of aromas to be introduced at predetermined time intervals so that different moods or state of minds can be created. The apparatus includes a tray having a

plurality of receptacles for various aromatic materials, and a heating means for heating a pre-selected receptacle, and thus aromatic material. The apparatus also includes a motor driven timer, that rotates the tray, so that the plurality of receptacles containing different aromatic materials are exposed to the heating means at a predetermined time period. The apparatus further includes a lid with a hole that exposes the pre-selected receptacle and aromatic material when the receptacle and aromatic material are exposed to the heating means. The aroma released from the heated aromatic material emanates into the environment through the hole. The remaining receptacles, which are out of close proximity to the heating means, are sealed to avoid the evaporation of the aromatic materials.

[0007] United States Patent No. 5,565,148 to Pendergrass, Jr. discloses an apparatus for delivering one or more aromas at selected times. The apparatus includes a housing with a receptacle and an aroma delivery device detachably received in the receptacle. The aroma delivery device includes a carrier having a plurality of aroma-bearing elements that are selectively communicated with an air passageway for providing one or more aromas as desired. The device is especially useful for providing a realistic sensory experience in an interactive or non-interactive use, and may be used in such diverse settings as the entertainment industry, the educational training field or a medical arena.

[0008] United States Patent No. 5,178,327 to Palamand, et al. discloses an air freshener that includes a container which carries a cartridge having a plurality of sections, each of which is filled with a porous material impregnated with a differently scented substance. At least the front wall of the container has an aperture of generally the same shape and size as the cartridge sections. The cartridge may be rotated within the container to selectively bring one of its sections into alignment with the aperture, in order to expose a scented substance in one of the sections to the ambient air contained within a room, causing evaporation of the scented substance and freshening of the room's air. The back wall of the container may also be provided with an aperture, which is in general axial alignment with the front wall aperture, and tape or the like surrounding the aperture, so that the air

freshener may be mounted over a vent or the like. In this manner, the fragrant scent will be spread into a room by force rather than by convection.

[0009] United States Patent No. 4,629,604 to Spector discloses a player for a multi-roma cartridge constituted by a planar array of like frame assemblies held within a multi-section framework, each assembly being formed by a pad of absorbent material sandwiched between a pair of frames whose margins are joined together to define a central zone exposing the pad. The pad of each assembly is impregnated with a liquid fragrance that differs from those of the others. When the cartridge is inserted in a slot in the player case, it lies over a complementary honeycomb, each of whose cells is then in registration with a respective assembly. The cells are provided with individual electric heaters such that when a selected cell heater is energized, it heats the air in the cell to produce a positive pressure therein that acts to force the heated air through the zone to volatilize the liquid fragrance, the resultant aromatic vapor being discharged into the atmosphere through vents in the case. The selection of aromas to be played may be effected manually or it may be synchronized to follow the scenes of a video tape or movie film presentation.

[0010] United States Patent No. 4,603,030 to McCarthy discloses a system for emitting, in sequence, a plurality of different scents. The system includes a plurality of holders for scent-bearing chips; a mechanism for propelling these scents from the system; a mechanism for selectively conveying any desired scent holder into operative relation with the propelling mechanism; and a mechanism for actuating the propelling mechanism to propel scent from any desired scent holder in response to a programmed, predetermined sequence of scents of predetermined duration.

#### SUMMARY OF THE INVENTION

[0011] The present invention is a device for playing a cartridge for dispersing scented materials into a room. The cartridge generally has a plurality of scent elements supported on a rotatable disk. The device includes a housing, a blower assembly, a platter, a motor, first and second sensors and a control unit. The

housing has a cavity for receiving the cartridge and is formed with an air intake and an exhaust port. The blower assembly is mounted within the housing for generating an airflow by drawing air in through the air intake over the cavity to diffuse at least one of the plurality of scent elements out through the exhaust port. The platter has a body defined by a perimeter and a center, a hub, and first and second position indicators. The hub is configured to removably engage the rotatable disk of the cartridge and is connected to the body at the center to define an axis of rotation. The first and second position indicators are connected to the body. The motor is mounted within the housing and coupled to the platter for rotating the platter about the axis of rotation so that the first position indicator rotates through a first circular path and the second position indicator rotates through a second circular path. The first sensor is arranged adjacent to a first point on the first circular path and generates a first signal when the first position indicator is rotated to the first point. The second sensor is arranged adjacent to a second point on the second circular path and generates a second signal when the second position indicator is rotated to the second point. The control unit is electrically coupled to: the first sensor, the second sensor, and the motor, and controls the current delivered to the motor to operate the motor. The control unit alters the current delivered to the motor upon receiving either the first signal from the first sensor or the second signal from the second sensor. The device also preferably includes a heating element positioned within the cavity for activating at least one of the plurality of scent elements.

[0012] In preferred embodiments of the invention, the first position indicator is a first tubular ring formed with at least one notch which is positioned to correspond with a home position of the rotatable disk of the cartridge. The second position indicator is a second tubular ring formed with a plurality of notches. Each notch is positioned to correspond with a location of one of the plurality of scent elements on the rotatable disk of the cartridge. The first and second sensors are preferably optical sensors configured to detect the location of the notches corresponding to the home position and location of the scent elements on the rotatable disk of the cartridge. The optical sensors are preferably formed with a

slot so that an edge of each respective tubular ring can ride within the slot. The device preferably includes a cover and a latch configured to cooperate to cover the cavity. The cover is rotatably connected to the housing and the latch is configured to maintain the cover in the closed position and is formed with a key. Preferably the perimeter of the platter is formed with a latch notch that corresponds to the home position of the rotatable disk. The latch notch is configured to receive the key so that the latch can be translated to open the cover when the platter is at the home position. The motor is preferably configured to be operated under direct current and is coupled to the platter through a plurality of gears to increase the torque delivered to the platter. The motor preferably includes a first terminal maintained at a ground potential and a second terminal maintained at a high potential during the operation of the motor. The control unit is preferably configured to alter the current delivered to the motor by at least one of:

- isolating one of the first and second terminals to stop the current flowing through the motor;

- providing an alternate path in parallel with the second terminal to divert current from flowing through the motor; and

- applying a substantially high potential to the first terminal.

[0013] During the operation of the device, the control unit is preferably configured to sequentially rotate the hub from the home location through each location of a scent element and back to the home location. The control unit is preferably configured to stop the rotation of the hub for a play period at each of the plurality of scent elements. When a heating element is included in the device, the control unit is preferably configured to operate the heating element during at least a portion of the play period.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

[0014] Preferred embodiments of the invention have been chosen for purposes of illustration and description and are shown in the accompanying drawings, wherein:

- Figure 1 is a perspective view of the present invention;

- Figure 2 is a top plan view of the present invention;

- Figure 3 is a side elevational view of the present invention;



Figure 4 is a front elevational view of the present invention;

Figure 5 is a rear elevational view of the present invention;

Figure 6 is a bottom plan view of the present invention;

Figure 7 is an exploded perspective view of the bottom housing, blower assembly, and portion of the platter drive assembly of the present invention;

Figure 8 is an exploded perspective view of the platter, heater assembly, and the main printed circuit board of the present invention;

Figure 9 is an exploded perspective view of the upper housing of the present invention;

Figure 10 is a cross-sectional view taken along line 10-10 on Figure 2 showing the general path that the air takes through the present invention without having a cartridge installed therein;

Figure 11 is a cross-sectional view taken along line 10-10 on Figure 2 showing the general path that the air takes through the present invention with a cartridge installed therein;

Figure 12 is a cross-sectional view taken along line 12-12 on Figure 3 showing a portion of the drive assembly and blower assembly;

Figure 13 is a cross-sectional view taken along line 13-13 on Figure 3 showing a portion of the drive assembly and blower assembly;

Figure 14 is a cross-sectional view taken along line 14-14 on Figure 3 showing the main printed circuit board and heater assembly;

Figure 15 is a first perspective view showing the bottom housing, drive assembly, and blower assembly of the present invention;

Figure 16 is a second perspective view showing the bottom housing, drive assembly, and blower assembly of the present invention;

Figure 17 is a perspective view similar to the view shown in Figure 15 with the platter shown installed on the drive assembly;

Figure 18 is a perspective view similar to the view shown in Figure 16 with the platter shown installed on the drive assembly;

Figure 19 is a top plan view of the platter;

Figure 20 is a cross-sectional view taken along line 20-20 on Figure 19 of the platter;

Figure 21 is a side elevational view of the platter;

Figure 22 is a bottom plan view of the platter;

Figure 23 is a partially cut away top perspective view similar of the present invention showing the latch engaging the platter;

Figure 24 is an enlarged detail of the latch engaging the platter shown in Figure 23;

Figure 25 is a bottom perspective view showing the main printed circuit board and a portion of the heater assembly;

Figure 26 is a first schematic view of the control unit shown in relationship to the platter;

Figure 27 is a perspective view showing the bottom housing, platter drive assembly, main printed circuit board and a portion of the heater assembly;

Figure 28 is an enlarged detail showing the relationship between main printed circuit board and the platter;

Figure 29 is a schematic diagram of a power supply circuit;

Figure 30 is a schematic diagram of the blower, heater and motor circuits;

Figure 31 is a schematic diagram of a circuit;

Figure 32 is a schematic diagram of a circuit;

Figure 33 is a schematic diagrams of the optical sensors;

Figure 34 is a perspective view showing the play-skip printed circuit board assembly;

Figure 35 is a perspective view showing the intensity printed circuit board assembly;

Figure 36 is a perspective view of a second embodiment of the present invention;

Figure 37 is a top plan view of the second embodiment of the present invention;

Figure 38 is a side elevational view of the second embodiment of the present invention;

Figure 39 is an exploded perspective view of the bottom housing, blower assembly, and portion of the platter drive assembly of the second embodiment of the present invention;

Figure 40 is an exploded perspective view of the platter, heater assembly, and the main printed circuit board of the second embodiment of the present invention;

Figure 41 is an exploded perspective view of the upper housing of the second embodiment of the present invention;

Figure 42 is a cross-sectional view taken along line 42-42 on Figure 37 showing the general path that the air takes through the second embodiment of the present invention without having a cartridge installed therein;

Figure 43 is a cross-sectional view taken along line 42-42 on Figure 37 showing the general path that the air takes through the second embodiment of the present invention with a cartridge installed therein;

Figure 44 is a cross-sectional view taken along line 44-44 on Figure 38 showing a portion of the drive assembly and blower assembly;

Figure 45 is a cross-sectional view taken along line 45-45 on Figure 38 showing a portion of the drive assembly and blower assembly;

Figure 46 is a cross-sectional view taken along line 46-46 on Figure 38 showing the main printed circuit board and heater assembly;

Figure 47 is a first perspective view showing the bottom housing, drive assembly, and blower assembly of the second embodiment of the present invention;

Figure 49 is a second perspective view showing the bottom housing, drive assembly, and blower assembly of the second embodiment of the present invention;

Figure 49 is a perspective view similar to the view shown in Figure 47 with the platter shown installed on the drive assembly;

Figure 50 is a perspective view similar to the view shown in Figure 48 with the platter shown installed on the drive assembly;

Figure 51 is a top plan view of the platter;

Figure 52 is a cross-sectional view taken along line 52-52 on Figure 51 of the platter;

Figure 53 is a side elevational view of the platter;

Figure 54 is a bottom plan view of the platter;

Figure 55 is a partially cut away top perspective view similar of the second embodiment of the present invention showing the latch engaging the platter; and

Figure 56 is an enlarged detail of the latch engaging the platter shown in Figure 55.

#### **DETAILED DESCRIPTION OF THE INVENTION**

[0015] Referring initially to Figures 1 through 11, the device 43 for dispersing volatile materials into the environment is configured to play a replaceable cartridge 42 that includes a plurality of different scent elements. The cartridge 42 is preferably designed so that all of the scent elements are sealed when the cartridge is removed from the device 43. The plurality of scent elements are generally supported on a rotatable disk formed with a plurality of pockets. The pockets are preferably arranged to have a blank space located between at least two of the pockets that defines a home position. The plurality of scent elements are preferably in the form of a gel, but can include: solids, liquids, beads, encapsulates, wicks, carrier materials, and combinations thereof. The scent elements preferably require some form of activation to prevent the scent element from prematurely volatilizing on its own.

[0016] The device generally plays the cartridge 42 by initially selecting and positioning one of the plurality of scent elements for diffusion. When the scent element is in the preferred form that requires activation, such as a gel, the scent element is next activated. The activated scent element is then diffused into the environment. In order to accomplish these steps in playing the cartridge 42, the device 43 generally includes a drive assembly 66, a heating assembly 68, a blower assembly 70, and a positioning assembly 72 contained within a housing. The device 43 also includes a control unit 73 that controls and coordinates the operation of the individual assemblies.

[0017] The cartridge 42 that is played by the device 43 is disclosed in a U.S. Patent Application entitled "Volatile Material-Containing Article" by Rachel Murdell and Stephan G. Bush filed on May 29, 2003, which is incorporated herein by reference. In order to play the cartridge 42, the drive assembly 66 generally needs to generate a torque of about 5 inch pounds to rotate the disk within the

cartridge 43 for positioning the scent elements. The blower assembly 70 preferably delivers an airflow at a constant velocity of about 800 feet per minute, and the heating assembly 68 preferably is configured to be heated to a temperature in a range from about 60 to about 120 degrees Celsius.

[0018] Referring to Figures 1 through 6, the device 43 includes a housing that contains the drive assembly 66, the heating assembly 68, the blower assembly 70, the positioning assembly 72, and the control unit 73 which are described in detail below. The housing generally includes a bottom housing 1, a top housing 2, a top cover 7, and a top cap 9, and is preferably made from a plastic.

[0019] Referring to Figures 15 and 16, the bottom housing 1 generally supports the drive assembly 66 and blower assembly 70 therein. The bottom housing 1 preferably includes a plurality of feet 16 made from an elastomer to provide slip resistance and to help reduce any vibrations associated with the blower assembly 70 and drive assembly 66. As shown in Figures 9, 10, 14, the top housing 2 generally supports the heating assembly 68 and the positioning assembly 72 above the bottom housing 1. The top cap 9 is mounted to the top housing 2 and is rotatably connected to the top cover 7.

[0020] The top cover 7 includes a lower portion 8 that defines a channel 49 that communicates with the blower assembly 70. The top cover 7 together with the lower portion 8 can be opened to provide access to a cartridge-receiving cavity 47 formed in the top housing 2 for installing the cartridge 42 therein. The lower portion 8 is preferably configured to cooperate with at least one torsion spring 38 and a spring damper 40 to hold the cover 7 in a substantially upright position after opening.

[0021] Referring now to Figure 4, the housing also includes a left control panel 10, a right control panel 11, and latch 31. The left control panel 10 supports an intensity button 12 that cooperates with switch SW2 on the intensity printed circuit board 33 which is shown in Figure 36. The right control panel 11 supports

a play/stop button 13 and a skip button 14 that cooperate respectively with switches SW4 and SW3 on the play-skip printed circuit board 34 which is shown in Figure 34.

[0022] Referring initially to Figures 10 and 11, the latch 31 is configured to cooperate with a lip 82 formed on the lower portion 8 of the top cover 7 to maintain the top cover in a closed position as shown in Figures 10 and 11. The latch 31 is biased by a latch torsion spring 37 supported by a spring latch shaft 15 against the lip 82 as shown in Figure 10 in the absence of pressure. The latch 31 preferably cooperates with the drive assembly 66 to lock the top cover 7 in a closed position after the drive assembly 66 has rotated the disk within the cartridge 42 from a home position. The drive assembly 66 and positioning assembly 72 preferably include a platter 19 that has a body 112 defined by a perimeter 88 and a center 114 with a hub 21 attached to the body 112 at the center 114, which is illustrated in Figures 19 through 22. The perimeter 88 is preferably formed with a latch notch 84 configured to receive a key 86 formed on the latch 31 as shown in Figures 23 and 24. The latch notch 84 is located on the perimeter 88 of the platter 19 corresponding to the home position of the cartridge 42. When the cartridge 42 is located in the home position, pressure applied to the latch 31 will translate the key 86 into the latch notch 84 while disengaging the latch 31 from the lip 82. However, when the cartridge 42 has been rotated out of the home position, pressure applied to the latch 31 will force the key 86 against the perimeter 88 of the platter 19 and the latch 31 will not be disengaged from the lip 82.

[0023] Referring now to Figures 8, 9, 10, 14, 23, and 25, the cartridge-receiving cavity 47 formed in the top housing 2 includes first and second rectangular shaped openings 74, 76 configured to cooperate respectively with an ejection member 41 and an electrical switch 78 (corresponding to switch SW1 shown on Figure 32). Referring now to Figure 10, the ejection member 41 is spring loaded to assist in removing a cartridge 42 that is installed in the cartridge-receiving cavity 47. The electrical switch 78 is supported by the main printed circuit board 32 as shown in Figure 25 and cuts off current to the main printed

circuit board 32 unless a cartridge 42 is installed in the cartridge-receiving cavity 47. The cartridge-receiving cavity 47 is also preferably formed with a tab 80 for engaging the cartridge 42. The cartridge 42 can be configured to cooperate with the tab 80 to not allow the disk within the cartridge 42 to rotate unless the cartridge 42 engages the tab 80.

[0024] Referring now to Figures 7, 13, and 15 through 18, the drive assembly 66 is mounted within the bottom housing 1 and includes a motor 35A and a plurality of gears 19, 20, 22, 23, 24, 26, 27, 28, 30 arranged to rotate a hub 21 about an axis of rotation 110. The hub 21 is configured to engage the rotatable disk within the cartridge 42. The motor 35A is preferably a DC powered motor that operates at about 12 volts to produce a torque of about 0.4 in-lbs with a motor speed about 250 r.p.m. A suitable motor is model WRF-500TB-12560 No. WCG-004Y-017 manufactured by Shenzhen Weizhen Motor Co., LTD. The motor 35A is preferably mounted to the bottom housing 1 by a motor retainer 6 as shown in Figures 7 and 13. The 12 volts of DC current is preferably provided through an external power pack that is configured to cooperate with jack 36 shown in Figures 5 and 7. The plurality of gears combine generally for about an overall 953:1 gear reduction to deliver at least 5 in-lbs torque at about a 3 second per revolution speed to the hub 21.

[0025] The overall 953:1 gear reduction is accomplished through the reduction by the separate combinations of the individual gears. The individual gears are generally defined by parameters including: outside diameter, pitch diameter, teeth number, pitch, and pressure angle. In a preferred embodiment of the invention, these parameters are about as follows:

| Gear       | Outside Diameter (millimeters) | Pitch Diameter (millimeters) | Number of gear teeth | Pitch (English) | Pressure Angle |
|------------|--------------------------------|------------------------------|----------------------|-----------------|----------------|
| platter 19 | 119.56                         | 117.45                       | 111                  | 24              | 20 degree      |

|                      |       |                    |   |    |           |
|----------------------|-------|--------------------|---|----|-----------|
| worm 20              | 14.81 | 12.7 (.500 inch)   | helical single thread to match worm gear 22 | 24 | 14.5      |
| worm gear 22         | 33.86 | 31.75 (1.250 inch) | 30  | 24 | 14.5      |
| first small gear 23  | 14.81 | 12.7 (.500 inch)   | 12  | 24 | 20 degree |
| second large gear 24 | 59.26 | 57.15 (2.250 inch) | 54  | 24 | 20 degree |
| second small gear 26 | 33.86 | 31.75 (1.250 inch) | 30  | 24 | 20 degree |
| third gear 27        | 43.38 | 41.28 (1.625 inch) | 39  | 24 | 20 degree |
| fourth large gear 28 | 46.56 | 44.45 (1.750 inch) | 42  | 24 | 20 degree |
| fourth small gear 30 | 25.4  | 23.19 (.917 inch)  | 22  | 24 | 20 degree |

[0026] The motor 35A is coupled to the worm 20 which engages worm gear 22. The worm gear 22 is coupled to first small gear 23 which engages second large gear 24. The second large gear 24 is preferably coupled to second small gear 26 by a second gear sleeve 25. The second small gear 26 engages third gear 27 which in turn engages fourth large gear 28. The fourth large gear 28 is coupled to fourth small gear 30 by a fourth gear sleeve 29. The fourth small gear 30 engages the platter 19 which has the hub 21 mounted thereon.



[0027] Referring to Figures 8, 11, 25, the heating assembly 68 generally includes a heating element 45 mounted to the top housing 2 within the device 43 and is configured to reach a temperature in a range from about 60 to about 120 degrees Celsius. The heating element 45 can be a resistive type heating element, and is preferably enclosed between a heater cover 18 and a heater plunger 17. Referring to Figure 10, the heating assembly 68 is configured to have a portion of the heater cover 18 protrude through a heater opening 46 in the cartridge-receiving cavity 47 formed in the top housing 2 before the cartridge 42 is installed. The heater cover 18 is preferably made from a metal such as stainless steel. The heater plunger 17 is preferably formed from a heat resistant plastic such as PBT (Polybutylene Terephthalate). The heating assembly 68 preferably includes a spring 39 to bias the heating element 45 against the cartridge 42 to ensure that the scent element within the cartridge 42 is heated efficiently as shown in Figure 11. The spring 39 is supported by a retainer 5 which is connected to the top housing 2. The heating element 45 is preferably selected so that it can be operated at various temperatures for adjusting the amount of scent element that is activated. The temperature of the heating element 45 can generally be adjusted by controlling the amount of current that passes through the heating element 45 over a given period of time. This can generally be accomplished by either regulating a constant value of current that is delivered to the heating element 45 in a substantially continuous manner, or by controlling the timing of sequentially pulsing the current that is delivered to the heating element 45.

[0028] Referring initially to Figures 7, 11 and 15, the blower assembly 70 is mounted within the bottom housing 1 and generally includes a blower wheel 4 and a motor 35B. The motor 35B is preferably a DC powered motor that operates at about 12 volts. A suitable motor is model WRF-500TB-12560 No. WCG-004Y-017 manufactured by Shenzhen Weizhen Motor Co., LTD. The motor 35B is preferably mounted to the bottom housing 1 and is retained therein by a portion of a blower housing 3 as shown in Figure 12. The blower wheel 4 is preferably a forward curved centrifugal blower which draws air in axially to the center and then expels the air out radially into a scroll 48 formed by the bottom housing 2 and the

blower housing 3. The air is drawn into the blower wheel 4 from an air intake defined by openings 50 formed in the bottom housing 2 at the bottom and rear of the device 43. The scroll 48 is arranged to direct the resulting airflow through a channel 49 formed in the lower portion of the top cover 8. The channel 49 directs the airflow over the cartridge-receiving cavity 47 to diffuse a scent element corresponding to the location of the heater element 45. As the airflow passes over an activated scent element, the airflow captures the resulting volatilized materials and carries them out through an exhaust port 51 formed in the top cover 7.

[0029] Referring initially to Figures 26 and 27, the positioning assembly 72 monitors the rotation of the hub 21 of the drive assembly 66 which in turn controls the positioning of the scent elements located within the cartridge 42. The positioning assembly 72 generally includes at least one position indicator 90 attached to the platter 19 to rotate through a circular path 92 and at least one sensor 96 arranged adjacent to a point 98 on the circular path 92 for generating a signal when the position indicator 90 is rotated to the point 98. In a first preferred embodiment of the positioning 72 assembly, the at least one position indicator 90 is a first ring 54 formed with at least one notch 56 attached to the platter 19 and the sensor 96 is an optical sensor 52 which is preferably mounted to the main printed circuit board assembly 32 as shown in Figures 14 and 25.

[0030] Referring now to Figures 8, 14, 17, and 27, a second preferred embodiment of the positioning assembly 72 generally includes first and second optical sensors 52, 53 and first and second rings 54, 55. The first and second optical sensors 52, 53 are preferably mounted at points 98, 100 on the main printed circuit board assembly 32 as shown in Figure 14. The main printed circuit board assembly 32 can be mounted between the platter 19 and the cartridge-receiving cavity 47 formed in the top housing 2 as shown in Figures 14 and 2. The optical sensors 52, 53 are preferably slot optical switches and can be configured schematically as shown in Figure 33. A suitable commercially available slot optical switch for both the first and second optical sensors 52, 53 is the ITR8402-

A/F3 slot optical switch manufactured by Everlight Electronics Co., Ltd. No 25, Lane 76, Chung Yang Rd, Sec. 3 Tucheng, Tapei 236, Taiwan, R.O.C.

[0031] The first and second rings 54, 55 are preferably tubular and are mounted to the platter 19 about the axis of rotation defined by the hub 21 as shown in Figures 19 and 20. The first ring 54 is formed with a home notch 56 which generally corresponds to a starting and stopping position for the disk within the cartridge 42 generally referred to as the home position. The second ring 55 is formed with a plurality of position notches 57. Each of the position notches 57 generally corresponds to the location of a scent element on the disk within the cartridge 42.

[0032] Referring now to Figures 26, 27, and 28, the first and second optical sensors 52, 53 are arranged on the main printed circuit board assembly 32 so that an edge 102, 104 of each of the first and second rings 54, 55 rides within the slot 106, 108 formed in each respective sensor 52, 53. When the drive assembly 66 is operating to rotate the platter 19, the notches 56, 57 on both the first and second rings 54, 55 are rotated through circular paths 92, 94. The first optical sensor 52 will detect the presence of the home notch 56 and send a signal to a control unit 73. Similarly, the second optical sensor 53 will detect the presence of the position notches 57 and will send a signal to the control unit 73. As discussed further below, the control unit 73 generally will stop the drive assembly 66 when the second optical sensor 53 detects one of the position notches 57 to play the scent element associated with that location. The device 43 includes the first optical sensor 52 and the first ring 54 formed with the home notch 56 to provide a signal to the control unit 73 that the disk is at the home position. The control unit 73 is configured to track the playing of the scent elements associated with the position notches 57 on the second ring 55.

[0033] In another alternative embodiment (not shown), the position indicators could be permanent magnets and the sensors could be magnetic sensors configured

to detect the presence of the permanent magnets. The magnets would be located at positions corresponding to the location of the notches as shown in Figure 19.

[0034] Referring initially to Figure 26, the control unit 73 generally includes a main printed circuit board 32, an intensity printed circuit board 33 and a play-skip printed circuit board 34. The control unit 73 is shown schematically in Figures 29 through 33.

[0035] A schematic diagram of a power supply circuit 59 is shown in Figure 24 where a 12V dc power source is preferably provided across pad1 and pad2, with the positive terminal of the 12V power source being provided on pad1 and ground being provided on pad2. The jack 36 shown in Figure 5 is preferably electrically connected to pad1 and pad2. An input terminal of a 12v-to-5v dc regulator 7805/7905 U1, which is commercially available from STMicroelectronics, 16350 West Bernardo Dr, San Diego - Rancho Bernardo, California 92127, is preferably connected to pad1 and an output terminal of the regulator U1 preferably provides a 5V dc power source or Vcc. Bypass capacitors (1000uF/25v) E1 and (220uF/16v) E2 are preferably connected in parallel across the 12V and 5V power sources, respectively.

[0036] Referring now to Figure 32, an eight-bit microcontroller EM78P153S U2, which is commercially available from Elan Microelectronics Corp., Ltd., No. 12, Innovation 1st Rd., Science-Based Industrial Park, Hsinchu City, Taiwan, having one-time-programmable (OTP) read only memory (ROM) is preferably provided to control the operation of the control unit 73 in accordance with software stored in the OTP ROM.

[0037] The series connection of a light emitting diode LED1, resistor R5, and switch SW1 is preferably connected across the 5v power source and a bias signal provided by the microprocessor U2. A node between the resistor R5 and the switch SW1 is connected to pin 2 of the microprocessor U2. The LED1 preferably provides an indication of a high setting for the device 43.

[0038] The series connection of a light emitting diode LED3, resistor R6, and switch SW2 is preferably connected across the 5v power source and the bias signal provided by the microprocessor U2. A node between the resistor R6 and the switch SW2 is connected to pin 3 of the microprocessor U2. The LED3 preferably provides an indication of a medium setting for the device 43.

[0039] The series connection of a light emitting diode LED2, resistor R7, and switch SW3 is preferably connected across the 5v power source and the bias signal provided by the microprocessor U2. A node between the resistor R7 and the switch SW1 is connected to pin 5 of the microprocessor U2. The LED2 preferably provides an indication of a low setting for the device 43.

[0040] The series connection of a light emitting diode LED4, resistor R8, and switch SW4 is preferably connected across the 5v power source and the bias signal provided by the microprocessor U2. A node between the resistor R8 and the switch SW4 is connected to pin 6 of the microprocessor U2. The LED4 preferably provides an indication that power has been applied to the device 43.

[0041] The microcontroller U2, LED1-LED4, and switches SW1-SW4 preferably incorporate two modes of operation. In a display mode, the bias signal is preferably input to the microcontroller U2. Pins 2, 3, 5, and 6 of the microcontroller U2 are used as outputs and selectively brought to a low level to energize the corresponding LED. In a select mode, the bias signal is preferably used as an output from the microcontroller U2 and the state of the switches SW1-SW4 are read on the corresponding pins 2, 3, 5, and 6 of the microcontroller U2.

[0042] A schematic diagram of the first optical sensor 52 and the second optical sensor 53 is shown in Figure 33. The first optical sensor 52 preferably includes a 3k ohm resistor R13 and a light emitting diode LED6 electrically coupled in series between the 12v power source and ground, as well as a photodetector LED8 and a 27k ohm resistor R15 electrically coupled in series

between the 5v power source and ground. A node between the resistor R15 and the photodetector LED8 is preferably connected to a home signal on pin 7 of the microcontroller U2 shown in Fig. 32.

[0043] When the light beam between LED6 and the photodetector LED8 is interrupted, the photodetector is preferably an open circuit and the microcontroller senses a high level (5v) on the home signal. Conversely, when the light beam between the LED6 and the photodetector LED8 is not interrupted, the photodetector is preferably a short circuit between the resistor R15 and ground and the microcontroller senses a low level (~0v) on the home signal.

[0044] Similarly, the second optical sensor 53 preferably includes a 3k ohm resistor R12 and a light emitting diode LED5 electrically coupled in series between the 12v power source and ground, as well as a photodetector LED7 and a 27k ohm resistor R14 electrically coupled in series between the 5v power source and ground. A node between the resistor R14 and the photodetector LED7 is preferably connected to a position signal on pin 7 of the microcontroller U2 shown in Fig. 32.

[0045] When the light beam between LED5 and the photodetector LED7 is interrupted, the photodetector is preferably an open circuit and the microcontroller senses a high level (5v) on the position signal. Conversely, when the light beam between the LED5 and the photodetector LED7 is not interrupted, the photodetector is preferably a short circuit between the resistor R14 and ground and the microcontroller senses a low level (~0v) on the position signal.

[0046] Referring now to Figure 30, a blower circuit 60 preferably includes a C945 transistor Q2 and a blower connector JK2 coupled to a collector of the transistor Q2. The remaining terminal of the blower connector JK2 is preferably connected to the 12v power source. The blower connector JK2 enables the blower motor 35B (not shown) to be readily coupled thereto.

[0047] The combination of a diode 1N4148 D2 and a 1k ohm resistor R2 are preferably connected in series between a heater+blower signal from pin 1 of the processor U2 and a base of the transistor Q2. A 47uF/16v electrolytic capacitor E3 is preferably connected between a node N1, which is located between the diode D2 and the resistor R2, and ground. The collector of the transistor Q2 is preferably also connected to ground.

[0048] When the heater+blower signal from the processor U2 is high, the transistor Q2 is preferably driven to an on state, which essentially grounds one terminal of the blower connector JK2 and permits current to flow through the motor 35B of the blower assembly 70. Conversely, when the heater+blower signal from the processor U2 is low and the charge stored in capacitor E3 is insufficient to maintain transistor Q2 in the on state, the transistor Q2 is preferably driven to an off state, which essentially isolates one terminal of the blower connector JK2 and stops current from flowing through the motor 35B.

[0049] The blower assembly 70 is preferably controlled during a pulse mode by applying a positive pulse to the heater+blower signal. The positive pulse is sufficient to charge the capacitor E3, which maintains transistor Q2 in the on state and keeps the motor 35B on. However, the positive pulse is preferably insufficient to activate an NMOSFET U3, which turns the heating element 45 on, as described in greater detail below.

[0050] Referring again to Figure 30, a heater circuit 62 preferably includes a heater connector JK3, which is coupled to a heating element 45 (not shown in Figure 30). One terminal of the heater connector JK3 is preferably connected to the 12v power source and the remaining terminal is preferably coupled to the drain of an enhancement mode n-channel field effect transistor NMOSFET U3, which is commercially available within a package of two devices as Part No. SDM4532 from Angus Technology Limited Workshop B, 7/F., Capital Trade Centre, No. 62, Tsun Yip Street, Kwun Tong, Kowloon, Hong Kong, China. The source of the NMOSFET U3 is preferably connected to ground.

[0051] The combination of a 1k ohm resistor R4 and a 1N4148 diode D3 is preferably coupled in series between the heater+blower signal from the processor U2 and a gate of the NMOSFET U3. A capacitor C3 is preferably connected between a node N19, which separates the resistor R4 and the diode D3, and ground. A 10k ohm resistor R19 is preferably connected between the gate of the NMOSFET U3 and ground.

[0052] When the heater+blower signal from the processor U2 is high, the NMOSFET U3 is preferably driven to an on state, which essentially grounds one terminal of the heater connector JK3 and permits current to flow through the heating element 45. Conversely, when the heater+blower signal from the processor U2 is low, the NMOSFET U3 is preferably driven to an off state, which essentially isolates one terminal of the heater connector JK3 and stops current from flowing through the heating element 45.

[0053] The heating element 45 is preferably controlled during a level mode by applying a dc level to the heater+fan signal. The dc level is sufficient to maintain transistor Q2 in the on state and keep the blower assembly 70 on, as well as turning the NMOSFET U3 on to keep the heating element 45 on. Thus, when the dc level is being applied during the level mode, both the blower assembly 70 and heating element 45 are on.

[0054] Referring again to Figure 30, a motor circuit 64 preferably includes a motor connector JK1, which is coupled to the motor 35A (not shown in Figure 30). One terminal of the motor connector JK1 is preferably connected to the 12v power source and the remaining terminal of the motor connector JK1 is preferably connected to a collector of a 2SD965 transistor Q1. The base of the transistor Q1 is preferably connected to a motor signal from pin 14 of the processor U2 through a 1k ohm resistor R1 and the emitter of the transistor Q2 is preferably connected to ground. The collector of the transistor Q1 is preferably connected to a source of an



enhancement mode p-channel field effect transistor PMOSFET U3 through a 1N4148 diode D1, as well as being connected to a drain of the PMOSFET U3.

[0055] The motor circuit 64 also includes a C945 transistor Q3, the collector of which is preferably connected to the source of the PMOSFET U3 through the series combination of a 10k ohm resistor R16 and a 1k ohm resistor R3. A node N3 separating the resistors R16 and R3 is preferably connected to a gate of the PMOSFET U3, and the emitter of the transistor Q3 is preferably connected to ground.

[0056] The base of the transistor Q3 is preferably coupled to ground through a 10k ohm resistor R18 and is preferably coupled to the collector of an A733 transistor Q4 through a 10k ohm resistor R17. The base of the transistor Q4 is preferably connected to the motor signal from pin 14 of the processor U2 through a 10k ohm resistor R9, and the emitter of the transistor Q4 is preferably coupled to the 5v power source.

[0057] When the motor signal from the processor U2 is high, the transistor Q1 is preferably driven on, which essentially grounds a first terminal 116 of the motor connector JK1 and permits current to flow through the motor 35A. In addition, when the motor signal is high, the transistor Q4 is off and the transistor Q3 is off. This open circuits the current path from the 12V power source through resistors R16, R3 and transistor Q3, which enables the maximum amount of current flow through the motor 35A. Also, when transistor Q3 is off, the PMOSFET U3 is off, which isolates the first and second 116, 118 terminals of the motor 35A across the PMOSFET U3.

[0058] Conversely, when the motor signal from the processor U2 is low, the transistor Q1 is preferably off, which essentially isolates the first terminal 116 of the motor connector JK1 from ground, which stops current from flowing through the motor 35A. In addition, when the motor signal is low, the transistor Q4 is preferably driven on, which drives the transistor Q3 on. This provides a current

path from the 12V power source through resistors R16, R3 and transistor Q3, which further diverts current flow from the motor 35A.

[0059] Also, when transistor Q3 is on, the PMOSFET U3 is driven on, which short circuits the first and second terminals 116, 118 of the motor 35A through the PMOSFET U3 to ensure that there is substantially no voltage drop between the first and second motor terminals 116, 118. Thus, the motor circuit 64 formed in accordance with the present invention provides at least three mechanisms that stop the rotation of the motor 35A in response to the motor signal from the processor U2 as rapidly as possible. Referring again to Figure 30, the following Table illustrates the approximate voltage and resistance values associated with positions shown on Figure 30 while the motor 35A is either running or stopped:

| <b>Table of Voltage and Resistance values at run and stop position of Motor 35A</b> |            |             |
|---|------------|-------------|
| <b>Position shown in Figure 30</b>  | <b>Run</b> | <b>Stop</b> |
| motor signal voltage  | 5V         | 0V          |
| MOSFET impedance  | high Z     | short       |
| N3 voltage  | 12V        | 1.07V       |
| N6 voltage  | 0V         | 12V         |
| N7 voltage  | 0V         | 0.7V        |
| N8 voltage  | 0V         | 12V         |
| N9 voltage  | 0.7V       | 0V          |

[0060] Figure 31 shows a thermistor R11 preferably coupled in series with a capacitor C2 between an SNR signal on pin 8 of the microcontroller U2 and ground. The thermistor R11 exhibits a determinable change in resistance due to changes in temperature, and thus the microcontroller U2 preferably uses the SNR signal as an input to monitor the temperature in the vicinity of the heating element 45.

[0061] A resistor R10 is preferably coupled in series with the capacitor C2 between a REF signal on pin 9 of the microcontroller U2 and ground. The microcontroller U2 preferably uses the REF signal as a reference for comparison with the SNR signal to cancel the effect of ambient temperature fluctuations. The microcontroller U2 preferably charges the capacitor C2 through a CRG signal, which couples pin 10 of the microcontroller U2 to the capacitor C2. The microcontroller U2 then monitors the width of the pulse on the SNR signal, which is dependent on the resistance of the thermistor R11, to determine the temperature in the vicinity of the heating element 45.

[0062] The operation of the device 43 will now be explained with reference to the drawings to further describe the present invention. A user will generally first provide power to the device 43 by plugging a 12V DC power pack into an outlet and connect the device to the 12V power supply through jack 36 shown in Figure 5. The user will next insert a cartridge 42 into the cartridge-receiving cavity 47 and close the top cover 7. The control unit 73 will now receive power because the cartridge 42 will depress the electrical switch 78 (SW1 on Figure 32) located in the cartridge-receiving cavity 47. The latch 31 will engage a lip 82 located on the lower portion 8 of the top cover 7 to initially maintain the device 43 in a closed position while the disk within the cartridge 42 and the platter 19 are located at the home position.

[0063] The user will next press the play button 13 on the right control panel 11 to start both the drive assembly 66 and the blower assembly 70. Once the platter 19 is rotated from the home position, the top cover 7 will be locked in the closed position until the platter 19 returns to the home position. Preferably LED4 on the play-skip printed circuit board 34 will blink as the disk is rotating to locate the first scent element over the heater assembly 68 to alert the user that the disk is being rotated. After the first scent element is located over the heating assembly 68, the heating element 45 will turn on, and preferably LED4 will go from a blinking state to a steady on state. The heating element 45 will generally turn on to a default setting for the intensity level, which can generally include low, medium, or

high. The intensity level is preferably displayed on the left control panel 10, which can be selected by pressing button 12. The control unit 73 can be configured to remember the last intensity level selected by the user for playing a cartridge 42. Preferably the control unit 73 monitors the temperature of the heating element 45 and pulses the current to the heating element 45 to maintain the desired intensity level. The temperature can generally be monitored using a thermistor R11 as shown on Figure 31.

[0064] A scent element in the cartridge 42 is generally played for a play period selected to be long enough for the user to comprehend and appreciate an aroma while not exceeding an interval of time in which the user would become desensitized to the aroma, which is sometimes referred to as "fragrance fatigue" or "habituation." See U.S. Patent Application Publication No.: US 2002/0068010 A1. The play period can be in a range from about 15 to 60 minutes, and is preferably about 30 minutes. The play period is also generally related to both a time for activating the scent element and a time for diffusing the activated scent element. Where the activation is performed by heating the scent element, it has been found that activation is generally not required through the entire play period in which the activated scent element will be diffused. Accordingly, it is preferable to activate the scent element for a shorter period than the play period selected for diffusing the activated scent element. The shorter period can be in a range from about 5 to 10 minutes, and is preferably about 8 minutes. For example, when the play period for diffusing an activated scent element is selected to be about 30 minutes, a suitable period for activating the element has been found to be about 22 minutes. This is beneficial in that it allows the scent element to cool for about 8 minutes before rotating the disk within the cartridge 42.

[0065] After the play period for diffusing the activated scent element (generally about 30 minutes) has expired, the control unit 73 will preferably rotate the disk to position the next scent element over the heating assembly 68. Again, preferably LED4 on the play-skip printed circuit board 34 will blink as the disk is being rotated. This process will generally repeat itself until the last scent element

is played. After the last scent element is played, the control unit 73 will continue to operate the blower assembly 70 while monitoring the temperature. The device 43 will finally rotate the disk into the home position after the temperature falls below 70C.

[0066] When a user decides to stop playing a cartridge before all of the scent elements are played, the user can press the play button 13 again. The electronic controls will turn the heating assembly 68 off, and preferably make LED4 blink again. The control unit 73 will also continue to operate the blower assembly 70 while monitoring the temperature. Once the temperature falls below 70C, the device 43 will rotate the disk into the home position and turn off the blower assembly 70 and LED4.

[0067] When a user decides to skip a scent element, the user can press the skip button 14. The control unit 73 will generally turn the heating assembly 68 off, and preferably make LED4 blink again. The control unit 73 will also continue to operate the blower assembly 70 while rotating the disk to the next position. Once the next scent element arrives at a position over the heating assembly 68, the normal program will resume. However, if the skip button 14 is pressed when the device 43 is playing the last scent element, the control unit 73 will operate the device 43 in the same manner as though the user pressed the play button (stop button) 13 again as described above to stop the device 43.

[0068] If the device 43 loses power during operation, the control unit 73 is configured to return the disk to the home position after power is restored. In addition, the device 43 will go into a standby mode where the unit has power.

[0069] Referring now to Figures 36 through 56, a second embodiment of the device 43 for dispersing volatile materials into the environment in accordance with the present invention is shown. The second embodiment generally includes modifications to the drive assembly 66, heating assembly 68, and positioning assembly 72 when compared with the first embodiment of the invention shown in

Figures 1 through 35. The operation of the device 43 and the details concerning the control unit 73 remain unchanged. The pertinent modifications are described in detail below.

[0070] Referring now to Figure 41, the spring damper 40 shown in Figures 8 and 15 is replaced with by a gear 40A and a plurality of teeth 40B combination. The top housing 2 includes the gear 40A configured to cooperate with the plurality of teeth 40B formed in the lower portion 8. As described above, the lower portion 8 is configured to cooperate with at least one torsion spring 38 to hold the cover 7 in a substantially upright position after opening. The gear 40A and teeth 40B combination assist in controlling the action of the torsion springs 38 when opening the cover 7. The gear 40A is preferably packed in grease selected to slow the action of the cover 7.

[0071] Referring now to Figures 51 through 54, the drive assembly 66 and positioning assembly 72 include a platter 19 similar too the first embodiment of the invention shown in Figures 19 through 22 where the latch notch 84A has a tapered profile. The latch notch 84A is again located on the perimeter 88 of the platter 19 corresponding to the home position of the cartridge 42. The tapered profile assists in ensuring that the latch 31 is returned to the closed position shown in Figure 42 during the operation of the device. This situation can arise when the top cover 7 is opened and then closed with the latch 31 not fully being returned to the closed position. The tapered profile smoothly biases the key 86 of the latch 31 back into the closed position as the platter 19 is rotated as shown in Figures 55 and 56.

[0072] Referring now to Figures 40, 41, 42, 46, and 55, the cartridge-receiving cavity 47 formed in the top housing 2 includes a pair of circular openings 74A and a rectangular shaped opening 76A configured to cooperate respectively with a pair ejection members 41A and an electrical switch 78A. The ejection members 41A include spring 41B to assist in removing a cartridge 42 that is installed in the cartridge-receiving cavity 47. The electrical switch 78A is supported by a bracket 78B connected to the bottom side of the cavity 47 as shown

in Figure 42 and cuts off current to the main printed circuit board 32 unless a cartridge 42 is installed in the cartridge-receiving cavity 47.

[0073] Referring now to Figures 45 and 47 through 50, the drive assembly 66 includes a motor 35A and a plurality of gears 19, 20, 22, 23, 24, 26, 27, 28, 30 arranged to rotate a hub 21 about an axis of rotation 110. The plurality of gears again combine generally for about an overall 953:1 gear reduction to deliver at least 5 in-lbs torque at about a 3 second per revolution speed to the hub 21 as described above in connection with the first embodiment of the invention.

[0074] The motor 35A is coupled to the worm 20 which engages worm gear 22. The worm gear 22 is coupled to first small gear 23 which engages second large gear 24. The worm gear 22 and the first small gear 23 are preferably formed as one part. The second large gear 24 is coupled to second small gear 26, and are preferably formed as one part. The second small gear 26 engages third gear 27 which in turn engages fourth large gear 28. The fourth large gear 28 is coupled to fourth small gear 30 by a fourth gear sleeve 29. The fourth large gear 28, fourth gear sleeve 29, and fourth small gear 30 are preferably formed as one part. The fourth small gear 30 engages the platter 19 which has the hub 21 mounted thereon.

[0075] In the second embodiment of the invention, the elevation of the first small gear 23; second large gear 24; second small gear 26; third gear 27; and fourth large gear 28 are raised relative to the platter 19 when compared with the first embodiment shown in Figures 15 through 18. In the first embodiment of the invention, the first small gear 23 is coupled to the bottom of worm gear 22. The elevation of the gears is raised substantially in the second embodiment by coupling the first small gear 23 to the top of the worm gear 22 as shown in Figures 39 and 47.

[0076] Referring to Figures 40 and 43, the heating assembly 68 is similar too the first embodiment of the invention shown in Figures 8 and 11 and includes a heating element 45 enclosed between a heater cover 18 and a heater plunger 17. In

the second embodiment, the heater cover 18 is connected to the heater plunger 17 by at least one fastener such as a screw.

[0077] Although illustrative embodiments of the present invention have been described herein with reference to the accompanying drawings, it is to be understood that the invention is not limited to those precise embodiments, and that various other changes and modifications may be effected by one skilled in the art without departing from the scope or spirit of the invention.



**WHAT IS CLAIMED IS:**

1. An apparatus for rotating an object comprising;  
a hub configured to removably engage the object and defining an axis of rotation;  
a motor coupled to said hub for rotating said hub about said axis of rotation;  
a first position indicator connected to said hub to rotate about said axis of rotation through a first circular path;  
a first sensor arranged adjacent to a first point on said first circular path and generating a signal when said first position indicator is rotated to said first point; and  
a control unit coupled to said first sensor and said motor, said control unit controlling current delivered to said motor to operate said motor and altering the current upon receiving said signal from said first sensor.
2. An apparatus for rotating an object as defined by Claim 1, wherein said first position indicator is a tubular ring formed with at least one notch associated with a location of said hub.
3. An apparatus for rotating an object as defined by Claim 2, wherein said first sensor is an optical sensor configured to detect said at least one notch.
4. An apparatus for rotating an object as defined by Claim 3, wherein said tubular ring includes an edge and said optical sensor is formed with a slot for said edge to ride within.
5. An apparatus for rotating an object as defined by Claim 1, wherein said first position indicator is a magnet and said first sensor is an magnetic sensor configured to detect said magnet.
6. An apparatus for rotating an object as defined by Claim 1, wherein said motor is operated under direct current and is coupled to said hub through a plurality of gears to increase the torque delivered to said hub.
7. An apparatus for rotating an object as defined by Claim 6, wherein said motor includes a first terminal maintained at a ground potential and a second terminal maintained at a high potential during operation of said motor; and  
said altering by said control unit includes at least one of:  
isolating one of the first and second terminals to stop the current flowing through said motor;

providing an alternate path in parallel with said second terminal to divert current from flowing through said motor; and

applying a substantially high potential to said first terminal.

8. An apparatus for rotating an object comprising:

a hub configured to removably engage the object and defining an axis of rotation;

a motor coupled to said hub for rotating said hub about said axis of rotation;

a first position indicator connected to said hub to rotate about said axis of rotation through a first circular path;

a second position indicator connected to said hub to rotate about said axis of rotation through a second circular path;

a first sensor arranged adjacent to a first point on said first circular path and generating a first signal when said first position indicator is rotated to said first point;

a second sensor arranged adjacent to a second point on said second circular path and generating a second signal when said second position indicator is rotated to said second point; and

a control unit coupled to said first sensor, said second sensor and said motor, said control unit controlling current delivered to said motor to operate said motor and altering said current upon receiving said first signal from said first sensor and said second signal from said second sensor.

9. An apparatus for rotating an object as defined by Claim 8, wherein said first position indicator is a first tubular ring formed with at least one notch associated with a home location of said hub.

10. An apparatus for rotating an object as defined by Claim 9, wherein said second position indicator is a second tubular ring formed with at least one notch associated with an intermediate location of said hub.

11. An apparatus for rotating an object as defined by Claim 10, wherein said first sensor is an optical sensor configured to detect said notch associated with said home location of said hub and said second sensor is an optical sensor configured to detect said at least one notch associated with said intermediate location of said hub.

12. An apparatus for rotating an object as defined by Claim 11, wherein said first and second tubular rings each include an edge and said optical sensors are each formed with a slot for each respective edge to ride within.

13. An apparatus for rotating an object as defined by Claim 8, wherein said first and second position indicators are magnets and said first and second sensors are magnetic sensors configured to detect said respective magnet.

14. An apparatus for rotating an object as defined by Claim 8, wherein said motor is operated under direct current and is coupled to said hub through a plurality of gears to increase the torque delivered to said hub.

15. An apparatus for rotating an object as defined by Claim 14, wherein said motor includes a first terminal maintained at a ground potential and a second terminal maintained at a high potential during operation of said motor; and

said altering by said control unit includes at least one of:

isolating one of the first and second terminals to stop the current

flowing through said motor;

providing an alternate path in parallel with said second terminal to

divert current from flowing through said motor; and

applying a substantially high potential to said first terminal.

16. A device for playing a cartridge for dispersing scented materials into a room, the cartridge having a plurality of scent elements supported on a rotatable disk, said device comprising:

a housing having a cavity for receiving the cartridge and being formed with an air intake and an exhaust port;

a blower assembly mounted within said housing for generating an airflow by drawing air in through said air intake over said cavity to diffuse at least one of the plurality of scent elements out through said exhaust port;

a platter having a body defined by a perimeter and a center, a hub connected to said body at said center to define an axis of rotation and being configured to removably engage the rotatable disk of the cartridge, a first position indicator connected to said body, and a second position indicator connected to said body;

a motor mounted within said housing and coupled to said platter for rotating said platter about said axis of rotation so that said first position indicator rotates through a first circular path and said second position indicator rotates through a second circular path;

a first sensor arranged adjacent to a first point on said first circular path and generating a first signal when said first position indicator is rotated to said first point;

a second sensor arranged adjacent to a second point on said second circular path and generating a second signal when said second position indicator is rotated to said second point; and

a control unit coupled to said first sensor, said second sensor and said motor, said control unit controlling current delivered to said motor to operate said motor and altering said current upon receiving said first signal from said first sensor and said second signal from said second sensor.

17. A device for playing a cartridge as defined by Claim 16, further comprising a heating element positioned within said cavity for activating at least one of the plurality of scent elements.

18. A device for playing a cartridge as defined by Claim 16, wherein said first position indicator is a first tubular ring formed with at least one notch corresponding with a home position of the rotatable disk of the cartridge.

19. A device for playing a cartridge as defined by Claim 18, wherein said second position indicator is a second tubular ring formed with at least one notch corresponding with a location of at least one of the plurality of scent elements on the rotatable disk of the cartridge.

20. A device for playing a cartridge as defined by Claim 18, wherein said second position indicator is a second tubular ring formed with a plurality of notches, each of said plurality of notches corresponding with a location of one of said plurality of scent elements on the rotatable disk of the cartridge.

21. A device for playing a cartridge as defined by Claim 19, wherein said first sensor is an optical sensor configured to detect said notch corresponding to the home position of the rotatable disk of the cartridge and said second sensor is an optical sensor configured to detect said at least one notch corresponding with a location of at least one of the plurality of scent elements on the rotatable disk of the cartridge.

22. A device for playing a cartridge as defined by Claim 21, wherein said first and second tubular rings each include an edge and said optical sensors are each formed with a slot for each respective edge to ride within.

23. A device for playing a cartridge as defined by Claim 16, wherein said first and second position indicators are magnets and said first and second sensors are magnetic sensors configured to detect said respective magnet.

24. A device for playing a cartridge as defined by Claim 16, wherein said motor is operated under direct current and is coupled to said platter through a plurality of gears to increase the torque delivered to said platter.

25. A device for playing a cartridge as defined by Claim 24, wherein said motor includes a first terminal maintained at a ground potential and a second terminal maintained at a high potential during operation of said motor; and  
said altering by said control unit includes at least one of:  
isolating one of the first and second terminals to stop the current  
flowing through said motor;  
providing an alternate path in parallel with said second terminal to  
divert current from flowing through said motor; and  
applying a substantially high potential to said first terminal.

26. A device for playing a cartridge as defined by Claim 20, wherein said control unit is configured to sequentially rotate said hub from the home location through each of the locations corresponding to one of the plurality of scent elements on the rotatable disk and back to the home location.

27. A device for playing a cartridge as defined by Claim 26, wherein said control unit is configured to stop the rotation of said hub for a play period at each of the plurality of scent elements.

28. A device for playing a cartridge as defined by Claim 27, further comprising a heating element positioned within said cavity for cooperating with at least one of the plurality of scent elements and coupled to said control unit; and wherein said control unit is configured to operate said heating element during at least a portion of said play period.

29. A device for playing a cartridge as defined by Claim 26, further comprising:  
a cover being rotatably connected to said housing for covering said cavity when in a closed position;  
a latch configured to maintain said cover in said closed position and being formed with a key; and  
wherein said perimeter of said platter is formed with a latch notch associated with said home location and configured to receive said key so that said latch can be translated to open said cover when said platter is at said home location.

30. A device for playing a cartridge as defined by Claim 29, further comprising:  
a torsion spring for biasing said cover towards a substantially upright position;  
and  
a gear rotatably connected to said housing; and  
wherein said cover is formed with a plurality of teeth configured to engage

said gear for controlling the biasing action associated with said torsion spring.

31. A device for playing a cartridge as defined by Claim 29, wherein said latch notch is formed with a tapered profile.

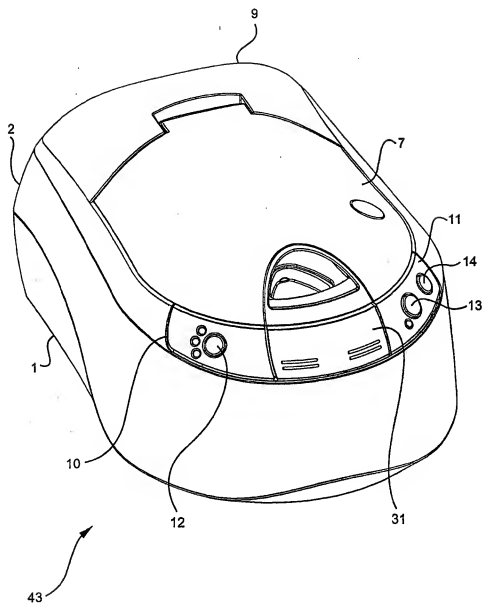
32. A device for playing a cartridge as defined by Claim 17, further comprising:

a heater plunger for supporting said heating element; and

a heater cover for covering said heating element; and

wherein said heater cover is connected to said heater plunger by at least one screw.

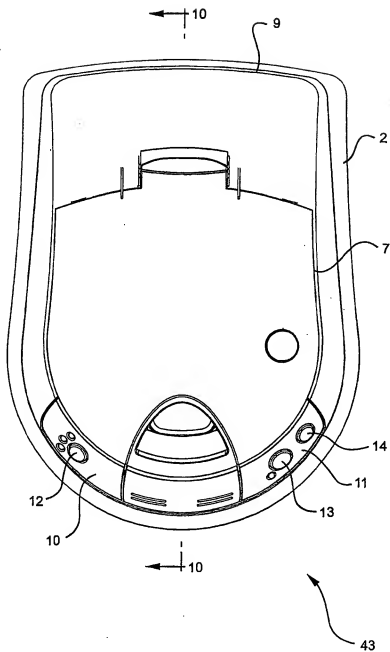
FIG. 1





2/54

FIG. 2



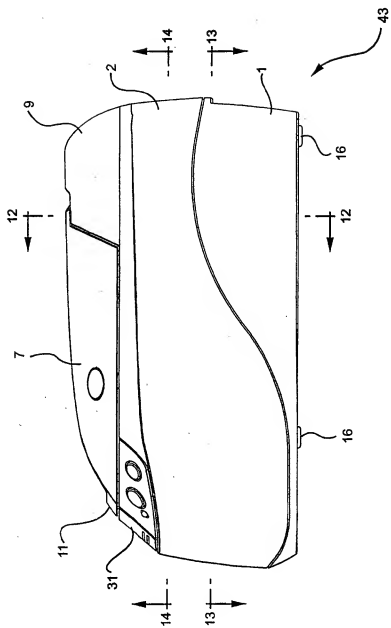


FIG. 3.

FIG. 4

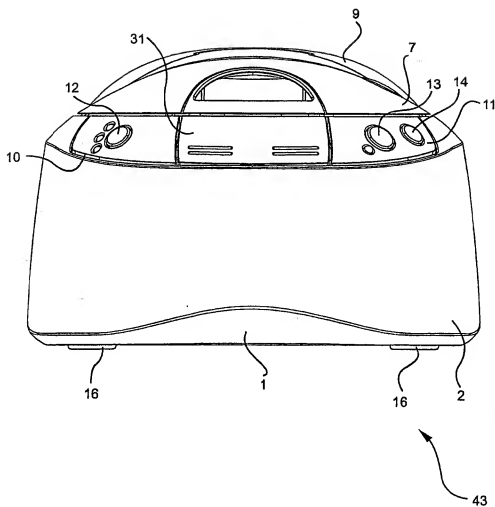


FIG. 5

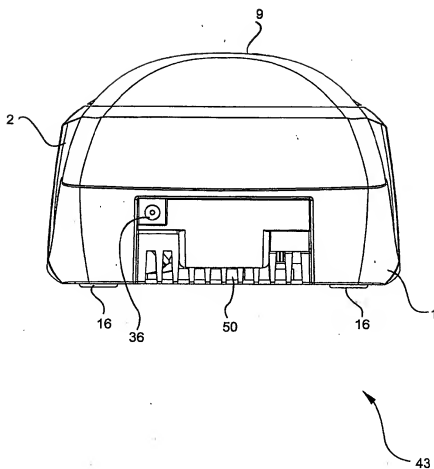


FIG. 6

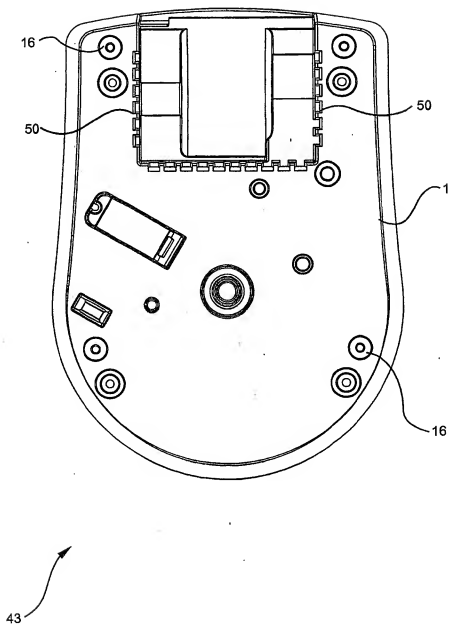


FIG. 7

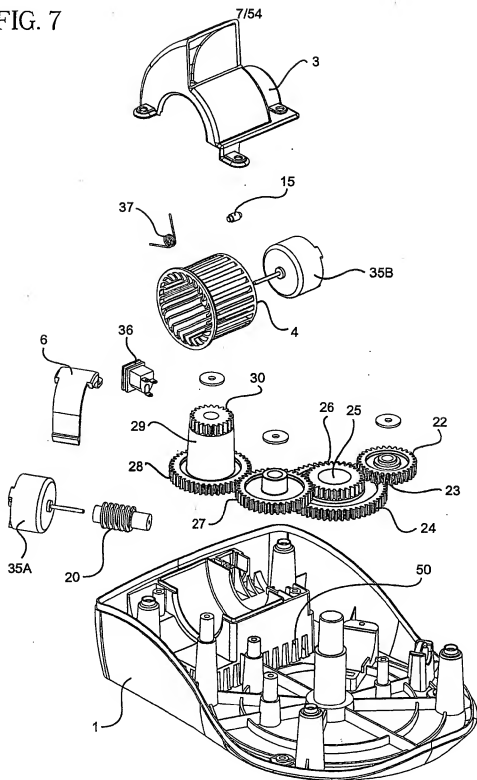


FIG. 8

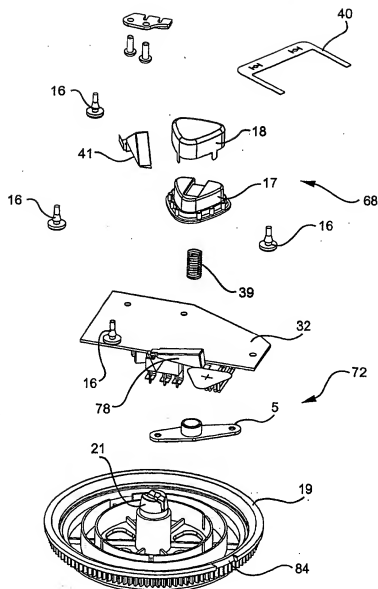
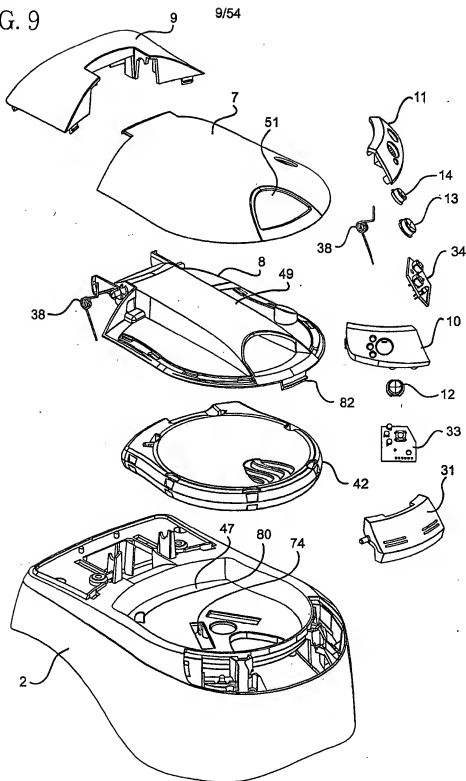
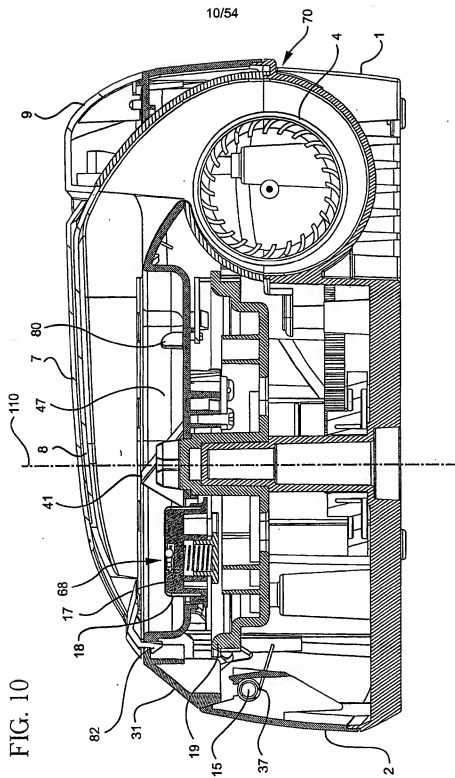
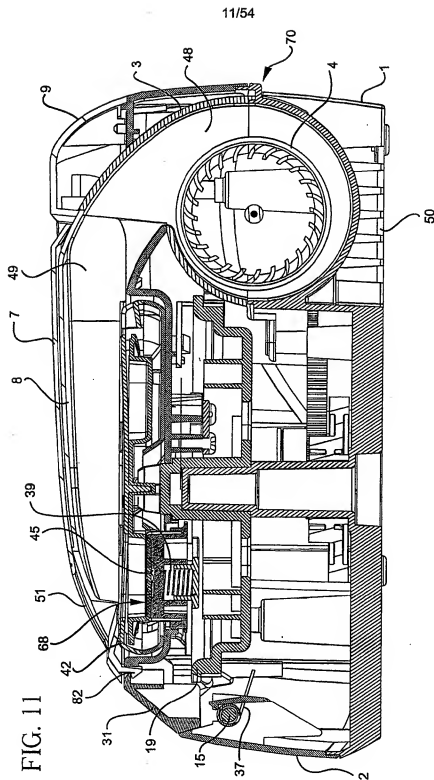


FIG. 9









12/54

FIG. 12

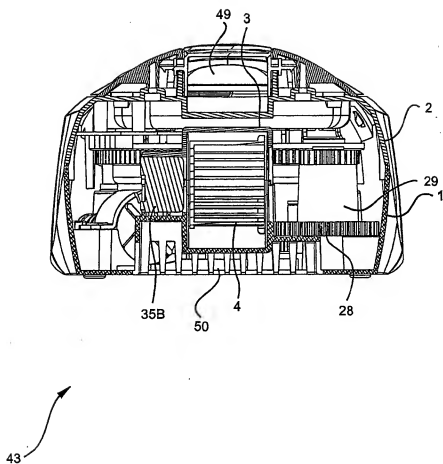


FIG. 13

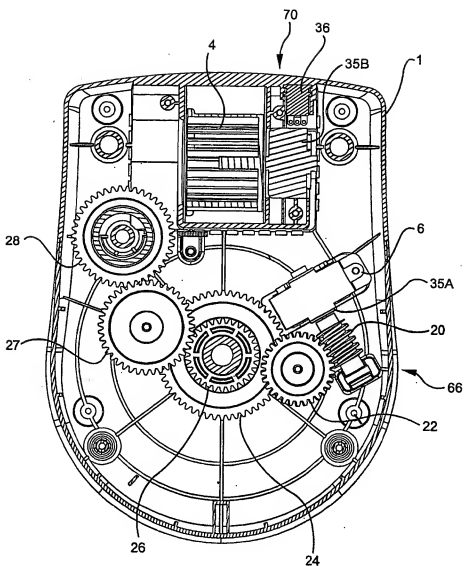
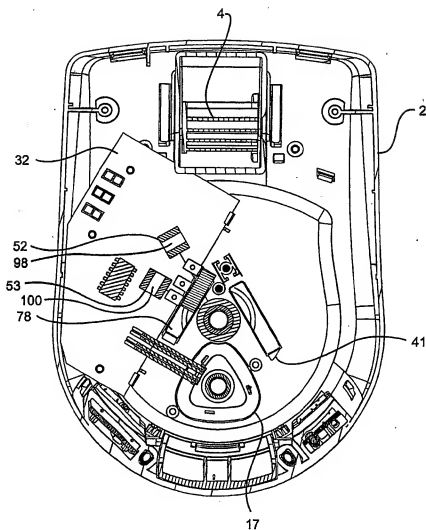
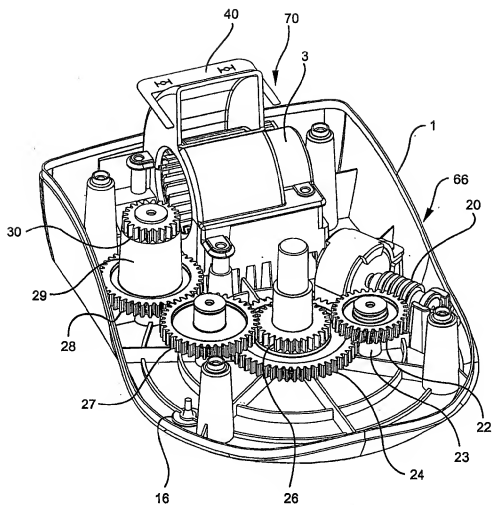


FIG. 14



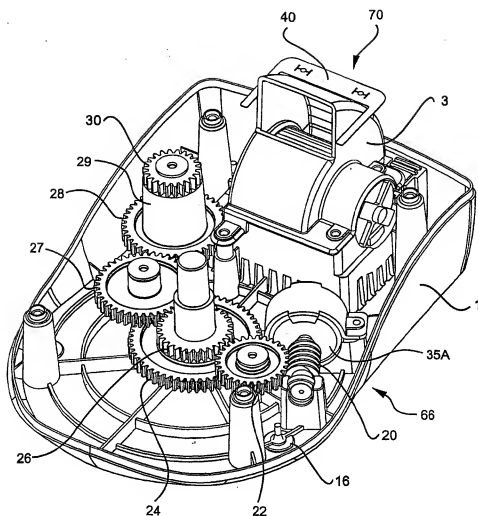
15/54

FIG. 15



16/54

FIG. 16



17/54

FIG. 17

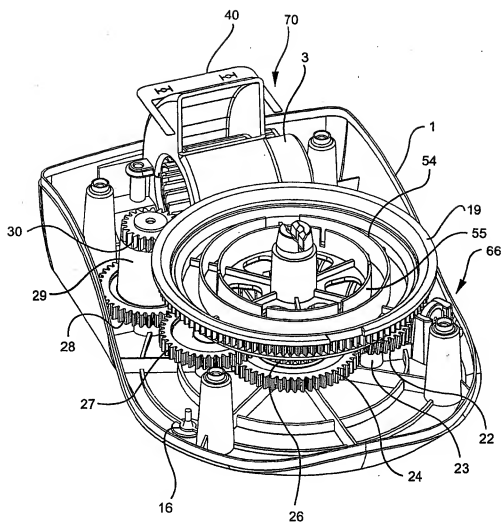
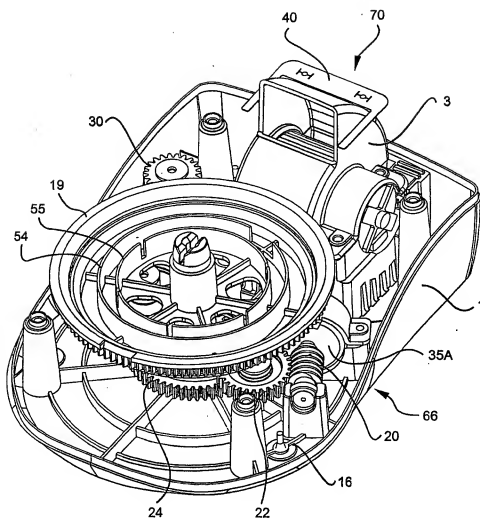


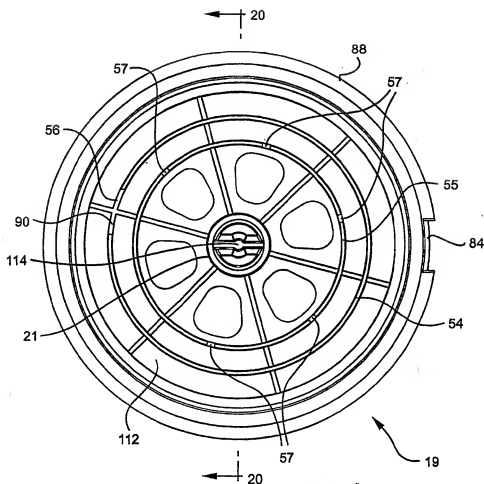


FIG. 18



19/54

FIG. 19



20/54

FIG. 20

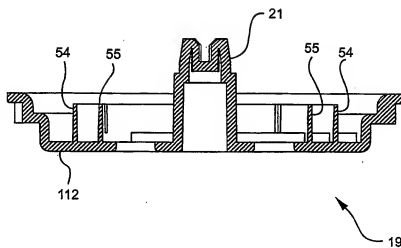
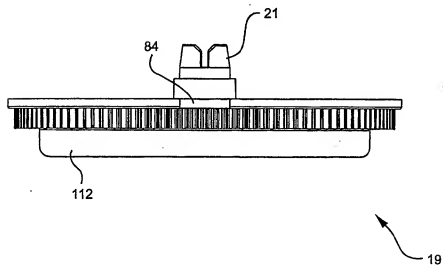
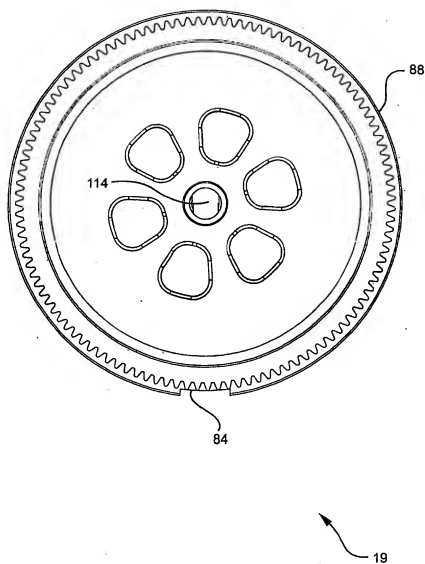


FIG. 21



21/54

FIG. 22



22/54

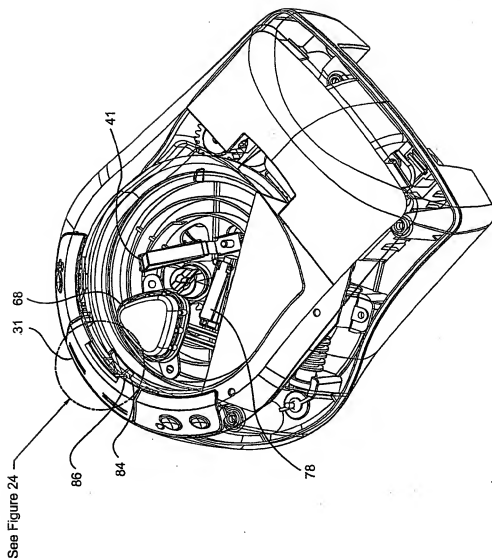
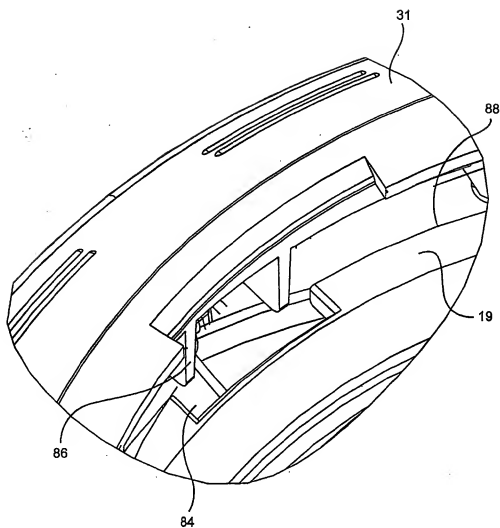


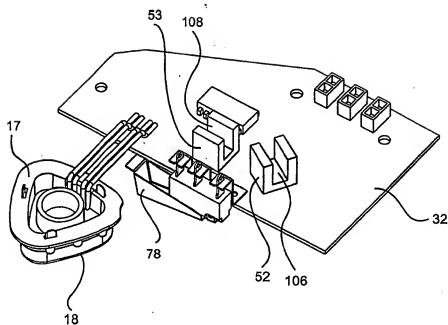
FIG. 23

FIG. 24



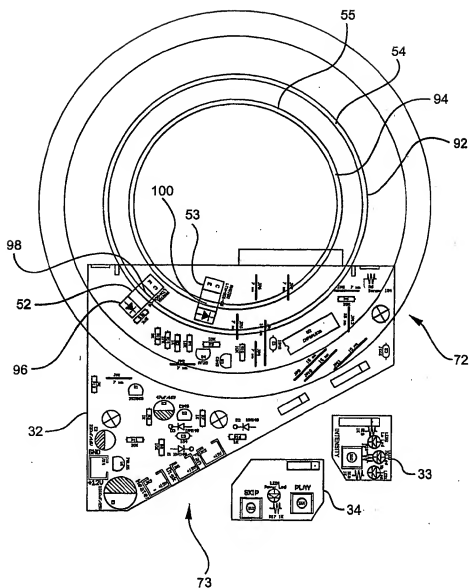
24/54

FIG. 25

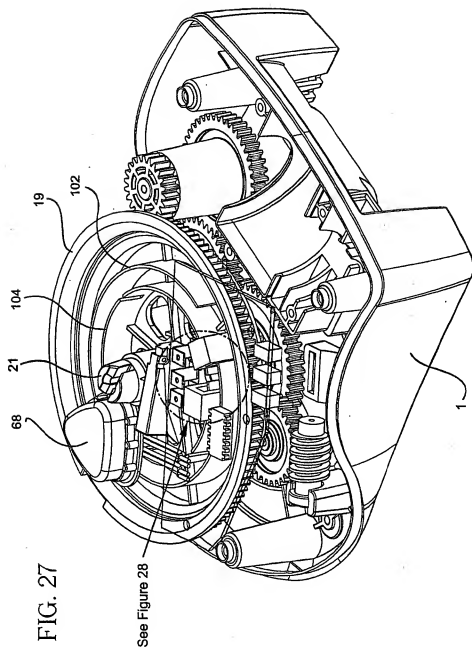


25/54

FIG. 26

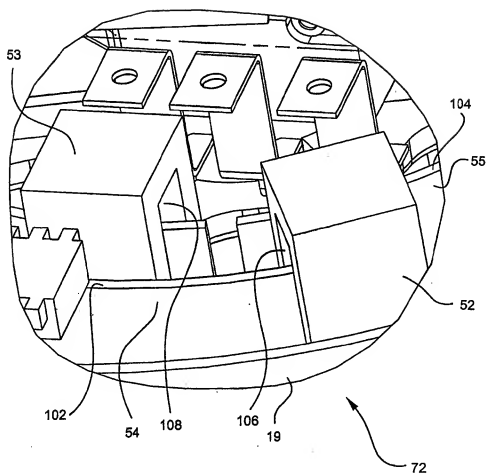






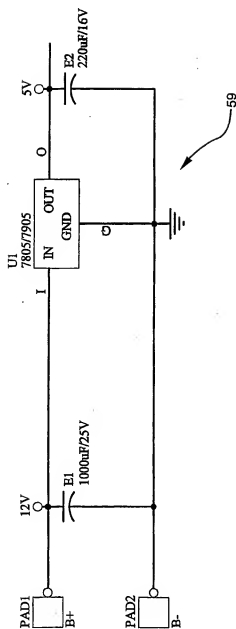
27/54

FIG. 28



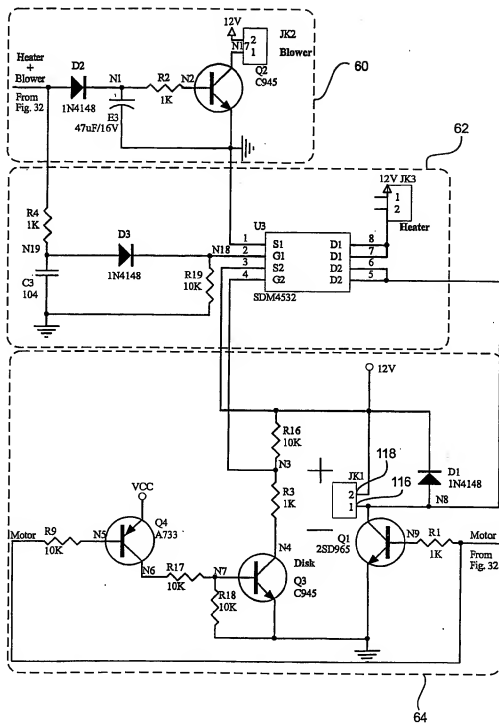
28/54

FIG. 29



29/54

FIG. 30



30/54

FIG. 31

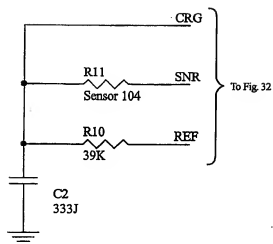
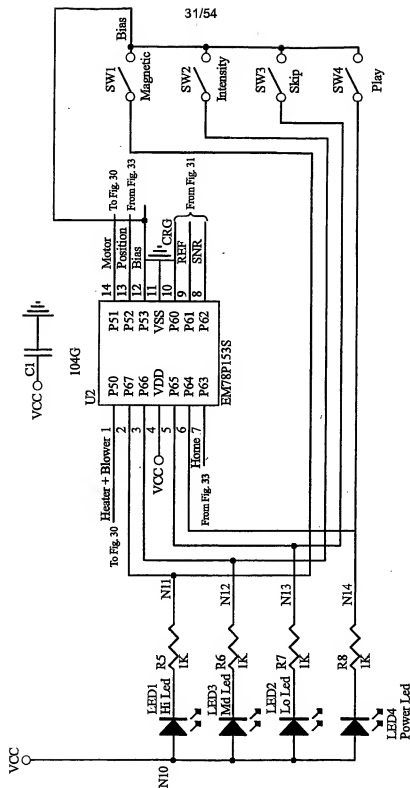


FIG. 32



32/54

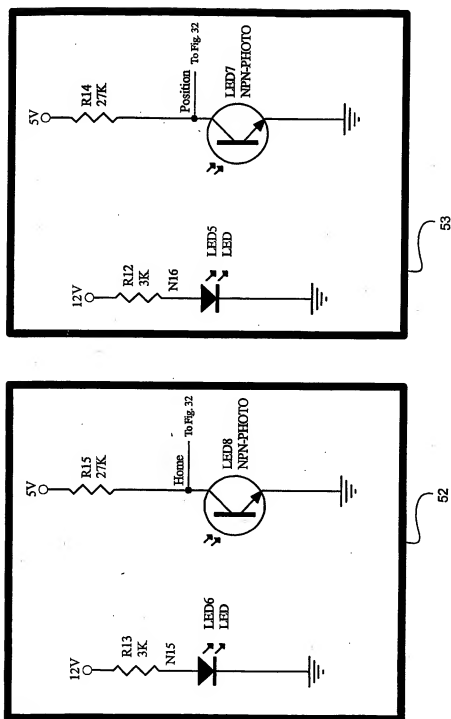
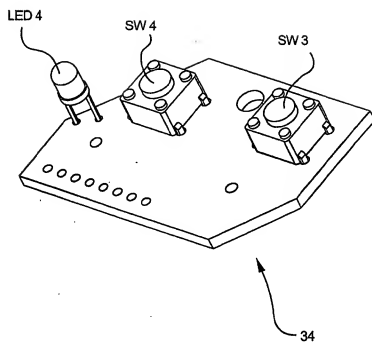


FIG. 33

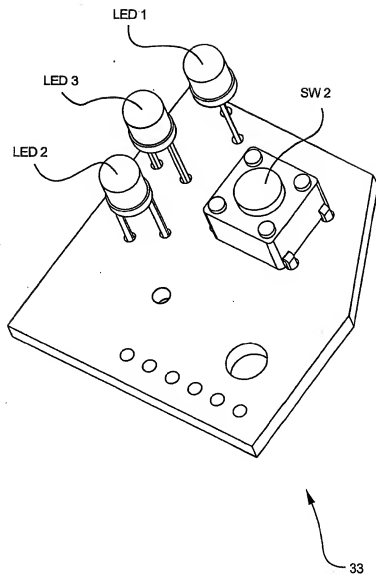
FIG. 34





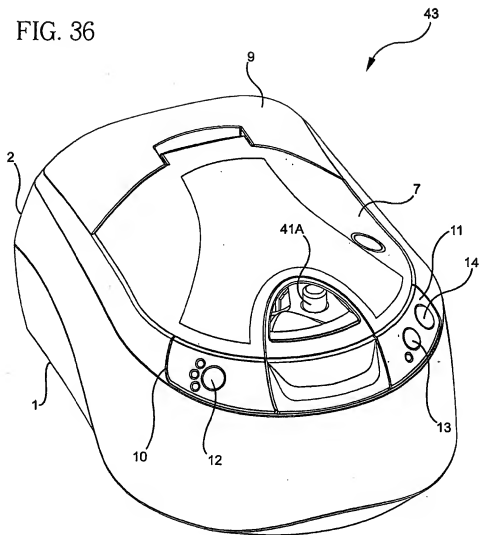
34/54

FIG. 35



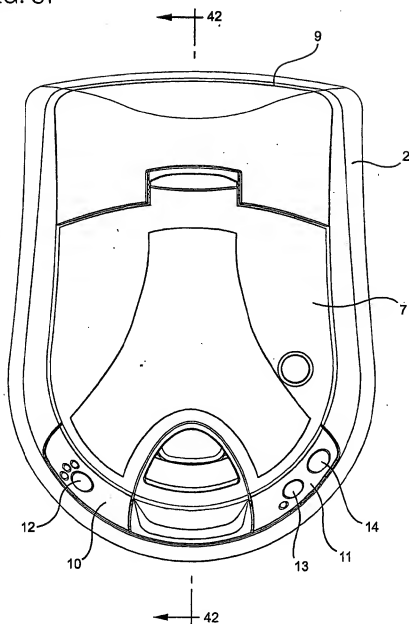
35/54

FIG. 36

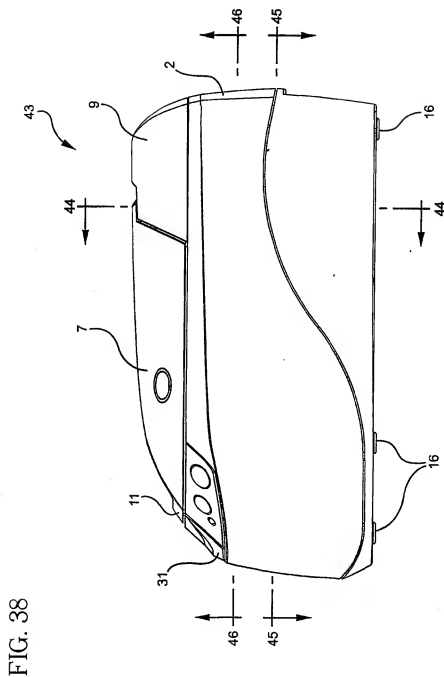


36/54

FIG. 37

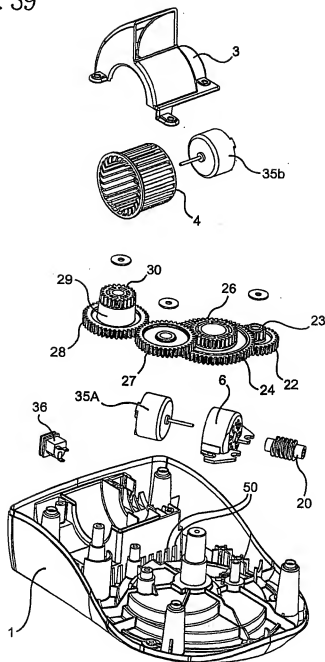


37/54



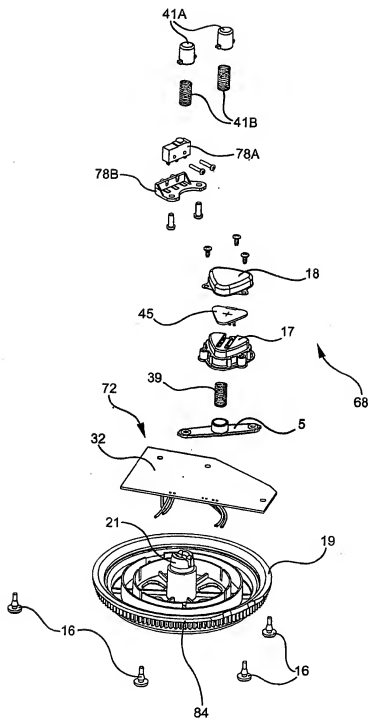
38/54

FIG. 39



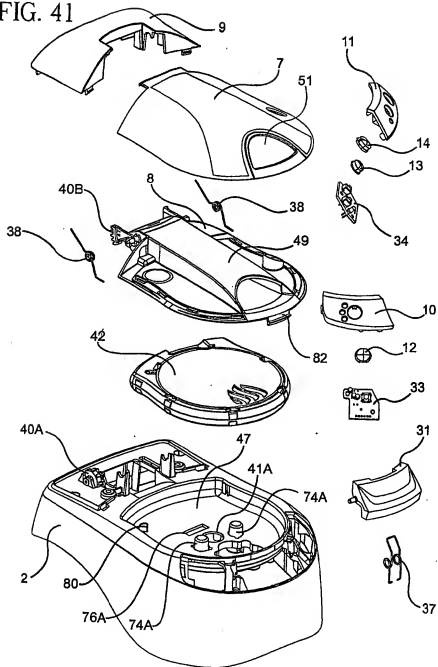
39/54

FIG. 40

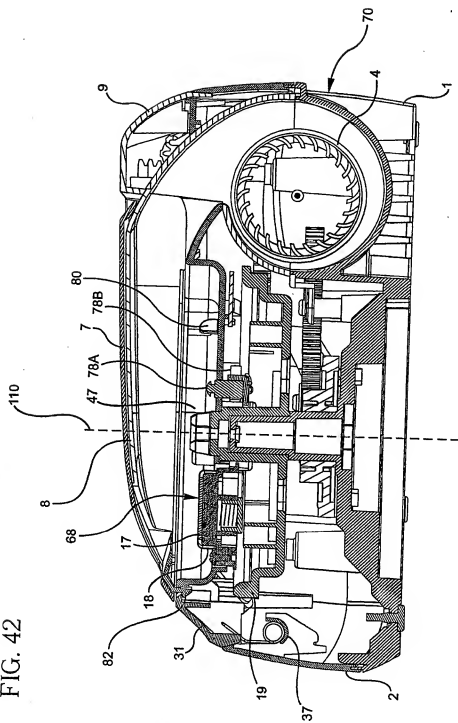


40/54

FIG. 41

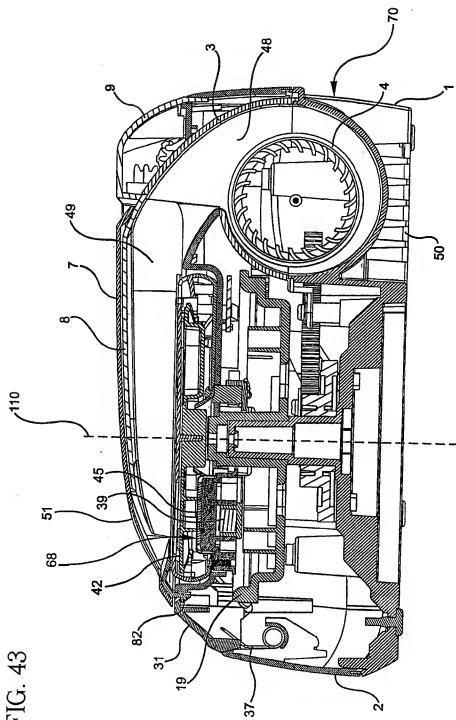


41/54





42/54



43/54

FIG. 44

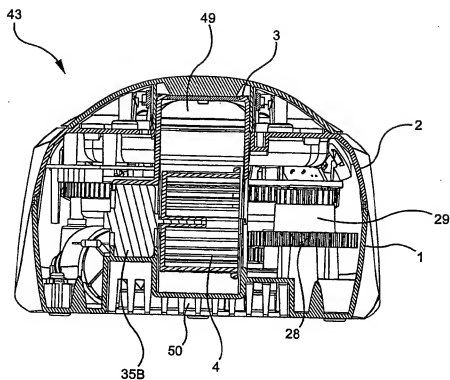
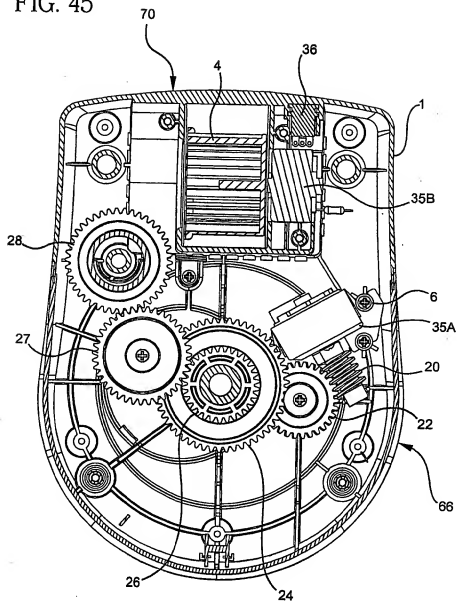
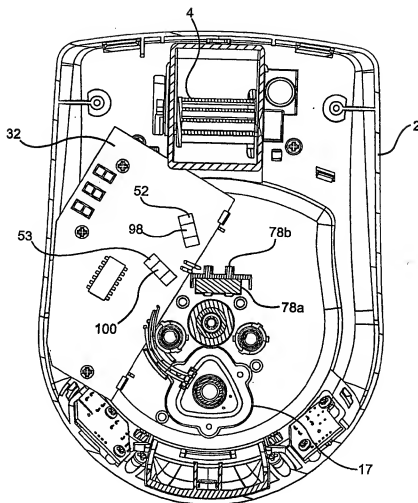


FIG. 45



45/54

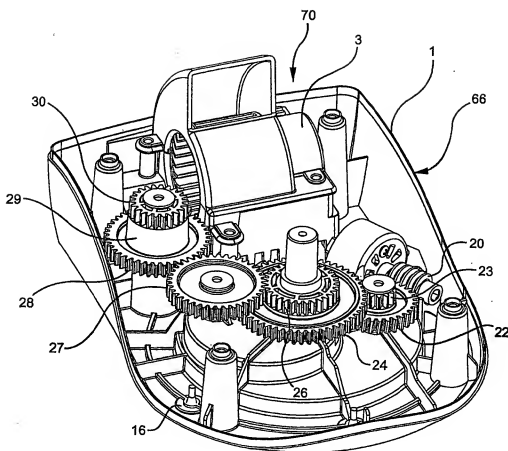
FIG. 46



BEST AVAILABLE COPY

46/54

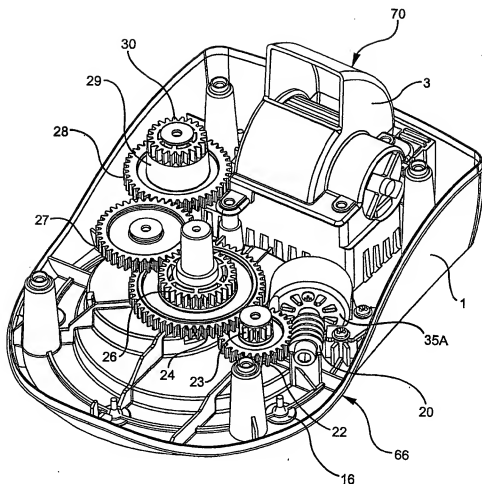
FIG. 47



BEST AVAILABLE COPY

47/54

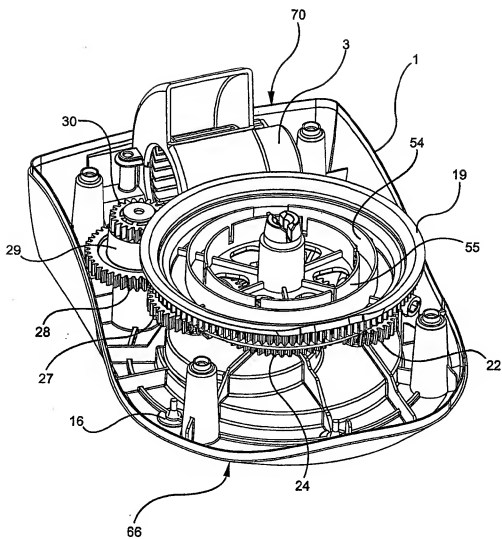
FIG. 48



BEST AVAILABLE COPY

48/54

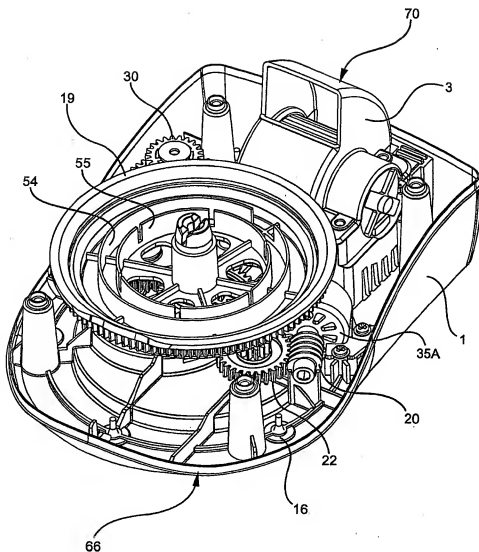
FIG. 49



BEST AVAILABLE COPY

49/54

FIG. 50

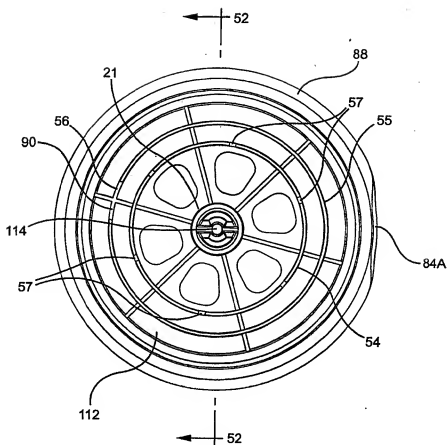


BEST AVAILABLE COPY



50/54

FIG. 51



51/54

FIG. 52

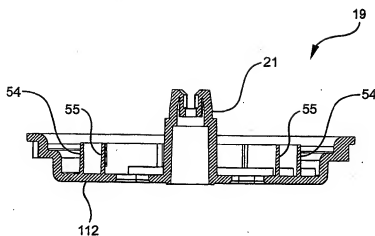
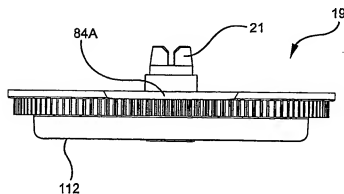


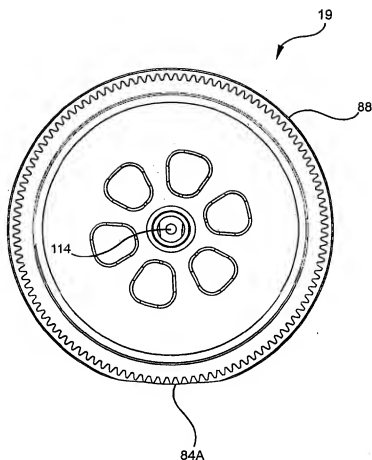
FIG. 53



BEST AVAILABLE COPY

52/54

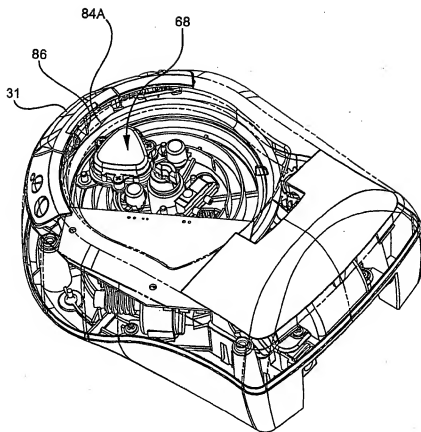
FIG. 54



BEST AVAILABLE COPY

53/54

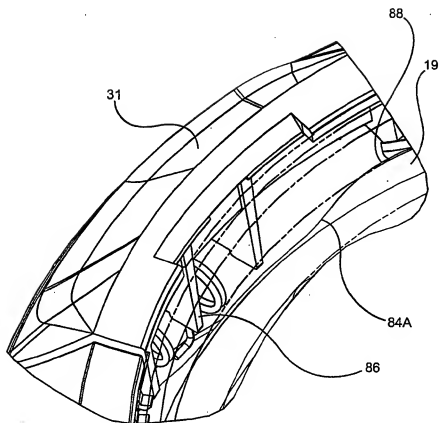
FIG. 55



BEST AVAILABLE COPY

54/54

FIG. 56



# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US04/16980

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : A62B 7/08  
US CL : 422/125, 4, 5, 105, 116, 122, 123; 261/30, DIG. 65;

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 422/125, 4, 5, 105, 116, 122, 123; 261/30, DIG. 65;

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
Please See Continuation Sheet

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages   | Relevant to claim No.             |
|------------|--|-----------------------------------|
| X<br>---   | US 5,658,387 A (REARDON et al) 19 August 1997 (19.08.1997), see column 9, 10 and 11. | 1-3, 8-12                         |
| Y          |  | 4-7, 13-32                        |
| X<br>---   | US 5,565,148 A (PENDERGRASS, JR.) 15 October 1996 (15.10.1996), see columns 5 and 7. | 16, 24                            |
| Y          |  | 23, 25                            |
| Y          | US 5,805,768 A (SCHWARTZ et al) 08 September 1998 (08.09.1998), see columns 3-4.     | 17, 29-32                         |
| X<br>---   | US 4,603,030 A (McCARTHY) 29 July 1986 (29.07.1986), see entire document.            | 1, 6, 8, 14, 16, 24               |
| Y          |  | 2-5, 7, 9-13, 15, 17-23 and 25-32 |

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

### \* Special categories of cited documents:

"A" documents defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" documents which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later documents published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

27 October 2004 (27.10.2004)

Date of mailing of the international search report

18 NOV 2004

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, Virginia 22313-1450

Facsimile No. (703) 305-3230

Authorized officer

Kenneth Jastrzebski

Telephone No. 703-308-0661

Form PCT/ISA/210 (second sheet) (January 2004)

BEST AVAILABLE COPY

Copied from 10500561 on 07/26/2007

**INTERNATIONAL SEARCH REPORT**

International application No.  
PCT/US04/16980

Continuation of B. FIELDS SEARCHED Item 3:

EAST

rotatic, motor, disc, scent, index, heat

## Trademark

| Docket Number | Country | Trademark             | Trademark Status | Application # | Filing Date |
|---------------|---------|-----------------------|------------------|---------------|-------------|
| 049687        | AR      | TOQUE ESTILO          | Searched         |               |             |
| 049667        | BR      | GLADE ESTILO          | Pending          | 826636004     | 14-Jun-2004 |
| 015892        | CA      | ESTILO                | Expd Renw.       | 516665        | 07-Feb-1984 |
| 049688        | CL      | TOQUE ESTILO & DESIGN | Pending          | 656062        | 09-Aug-2004 |
| 049689        | CO      | TOQUE ESTILO          | N/Interest       |               |             |
| 049690        | CR      | TOQUE ESTILO & DESIGN | Pending          |               |             |
| 049691        | EC      | TOQUE ESTILO          | N/Interest       |               | 22-Feb-2005 |
| 014525        | ES      | ESTILO LABEL          | Rejected         | 1034852       | 20-Apr-1983 |
| 049693        | GT      | TOQUE ESTILO & DESIGN | Pending          | M6472004      | 03-Sep-2004 |
| 049694        | HN      | TOQUE ESTILO & DESIGN | Pending          | 15325/2004    | 26-Aug-2004 |
| 049695        | MX      | TOQUE ESTILO & DESIGN | Dispatched       |               |             |
| 049696        | NI      | TOQUE ESTILO & DESIGN | Pending          | 200402671     | 27-Aug-2004 |
| 049697        | PA      | TOQUE ESTILO & DESIGN | Pending          | 137199        | 30-Aug-2004 |
| 049699        | PE      | TOQUE ESTILO          | N/Interest       |               |             |
| 015108        | PT      | ESTILO                | Abandoned        |               |             |
| 049698        | PY      | TOQUE ESTILO          | Searched         |               |             |
| 049692        | SV      | TOQUE ESTILO & DESIGN | Registered       | 20040055020   | 27-Aug-2004 |
| 049700        | UY      | TOQUE ESTILO          | Searched         |               |             |
| 019848        | VE      | ESTILO                | N/Interest       |               |             |
| 049701        | VE      | TOQUE ESTILO          | N/Interest       |               |             |

Copied from 10500561 on 07/26/2007



**This Page is Inserted by IFW Indexing and Scanning  
Operations and is not part of the Official Record**

**BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☐ FADED TEXT OR DRAWING
- ☐ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☐ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☒ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: \_\_\_\_\_

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.**